1991-03-08-OA-FEA

CASTLE JUNCTION INTERCHANGE

City and County of Honolulu, Hawaii

Project No. RF-061-1(17)

ENVIRONMENTAL ASSESSMENT

Negative Declaration
and
Finding of No Significant Impact (FONSI)

FILE COPY

NOTICE OF DETERMINATION
NEGATIVE DECLARATION FOR THE PROPOSED
CASTLE JUNCTION INTERCHANGE, PROJECT NO. RF-061-1(17)

A. Proposing Agency

Highways Division, Department of Transportation, State of Hawaii

B. Approving Agency

Department of Transportation, State of Hawaii

C. Description of the Proposed Action

The proposed project involves construction of a highway interchange to replace the existing at-grade intersection at the junction of Pali Highway, Kalanianaole Highway (FAP Route 61) and Kamehameha Highway (FAP Route 83), also known as Castle Junction (Figure 1). Alternative C (see Figure 4 in the Environmental Assessment) has been selected for further design and construction.

The location of the project is on the windward (northeastern) side of Oahu. Castle Junction is the first intersection north of the Pali Tunnels. The intersection is the focal point of a number of major routes on the windward side of the island. Kalanianaole-Pali Highway connects the suburban areas of Kailua and Waimanalo with Honolulu which is the urban, business, and government center of the State of Hawaii. Honolulu is 7.7 miles south of Castle Junction and is separated by the Koolau mountain range. Kamehameha Highway connects to Kaneohe and Auloa Road leads to the Maunawili area.

D. Determination

The proposed action would not have a significant effect on the environment. Section 12, "Significance Criteria," of Hawaii Administrative Rules Title 11, Chapter 200, "Environmental Impact Statement Rules" were reviewed and analyzed. Based on the analysis, the following were concluded:

1. no irrevocable commitment to loss or destruction of any natural or cultural resource would result;

2. the action would not curtail the range of beneficial uses of the environment;

3. the proposed action does not conflict with the state's long-term environmental policies or goals and guidelines;

4. the economic or social welfare of the community or state would not be substantially affected;

5. the proposed action does not substantially affect public health;

6. no substantial secondary impacts, such as population changes or effects on public facilities, are anticipated;

7. no substantial degradation of environmental quality is anticipated;

8. the proposed action does not involve a commitment to larger actions, nor would cumulative impacts result in considerable effects on the environment;

9. no rare, threatened or endangered species or their habitats would be affected;

10. air quality, water quality or ambient noise levels would not be detrimentally affected;

11. the project would not effect environmentally sensitive areas such as flood plains, tsunami zones, erosion-prone areas, geologically hazardous lands, estuaries, fresh waters or coastal waters.

E. <u>Reasons Supporting Determination</u>

The Environmental Assessment (EA) for the proposed action, documenting the potential environmental impacts, the public informational meetings, the public hearing and the coordination undertaken with affected agencies and parties is attached to support the determination of a Negative Declaration.

F. <u>Name, Address and Phone Number of Contact Person</u>

Mr. Ronald Tsuzuki
Head Planning Engineer,
Planning Branch
Highways Division
600 Kapiolani Boulevard, Room 301
Honolulu, Hawaii 96813
Phone: 548-3829

RECEIVED AND ACCEPTANCE RECOMMENDED

By ______________________ 1/31/91
Tetsuo Harano, Chief
Highways Division
Date

CONCURRENCE

By ______________________ 1/31/91
Edward Y. Hirata, Director
Department of Transportation
Date

FEDERAL HIGHWAY ADMINISTRATION (FHWA)
FINDING OF NO SIGNIFICANT IMPACT
FOR
CASTLE JUNCTION
PROJECT NO. RF-061-1(17)

The FHWA has determined that Alternative C will not have any significant impact on the human environment. This FONSI is based on the attached Environmental Assessment (EA), which has been independently evaluated by the FHWA and determined to adequately and accurately discuss the environmental issues and impacts of the proposed project. It provides sufficient evidence and analysis for determining that an environmental impact statement is not required. The FHWA takes full responsibility for the accuracy, scope and content of the attached EA.

2-5-91	[signature]	WILLIAM R. LAKE Division Administrator
Date	For FHWA	Title

Environmental Assessment

Negative Declaration
and
Finding of No Significant Impact (FONSI)

CASTLE JUNCTION INTERCHANGE

City and County of Honolulu, Hawaii

Project No. RF-061-1(17)

Volume 1

ENVIRONMENTAL ASSESSMENT

Negative Declaration
and
Finding of No Significant Impact (FONSI)

Submitted Pursuant to 42 USC 4332(2)(c)
and
Chapter 343, Hawaii Revised Statutes (HRS)

Proposing Agency:

State of Hawaii Department of Transportation
Highways Division

In Coooperation With:

U.S. Department of Transportation
Federal Highway Administration

Approving Agency:

State of Hawaii
Department of Transportation

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1.0 PROJECT DESCRIPTION

The proposed project involves construction of a highway interchange to replace the existing at-grade intersection at the junction of Pali Highway, Kalanianaole Highway (FAP Route 61) and Kamehameha Highway (FAP Route 83), also known as Castle Junction (Figure 1). The proposed improvements would provide one or more overpass or underpass structures and ramps connecting Pali, Kamehameha and Kalanianaole Highways.

The location of the project is on the windward (northeastern) side of Oahu. Castle Junction is the first intersection north of the Pali Tunnels. The intersection is the focal point of a number of major routes on the windward side of the island. Kalanianaole-Pali Highway connects the suburban areas of Kailua and Waimanalo with Honclulu which is the urban, business, and government center of the State of Hawaii. Honolulu is 7.7 miles south of Castle Junction and is separated by the Koolau mountain range. Kamehameha Highway connects to Kaneohe and Auloa Road leads to the Maunawili area.

The windward communities surrounding Castle Junction have experienced considerable growth, and traffic volumes entering and leaving Castle Junction have increased correspondingly. Average daily trips (ADT) on Pali Highway near Castle Junction has increased from 33,000 in 1970 to over 51,000 currently. Similarly, on Kamehameha Highway the ADT has increased from 17,000 in 1970 to 31,000 currently. Congestion in the area has worsened as the result of the increase in traffic volumes.

The existing at-grade intersection lacks the traffic carrying capacity to handle present and future peak hour travel demand. The existing volume to capacity ratios (V/C) for A.M. and P.M. peak hours are 1.59 and 1.35 respectively. Both of these V/C ratios correspond to a Level-of-Service F, the worst possible, and indicate a total breakdown of traffic flow with stop-and-go operations.

In addition, various design aspects of the intersection and adjoining highway sections are inadequate. For example, shoulder width along Kalanianaole south bound lanes is below standard. This problem is exacerbated in times of heavy rain by falling debris and soil erosion from the steep exposed cut adjacent to this section of roadway.

Current conditions at the intersection are unacceptable. Even with completion of the H-3 project, future congestion is expected to remain intolerable or in fact worsen. This would result in increased vehicular emissions and loss of valuable time to commuters.

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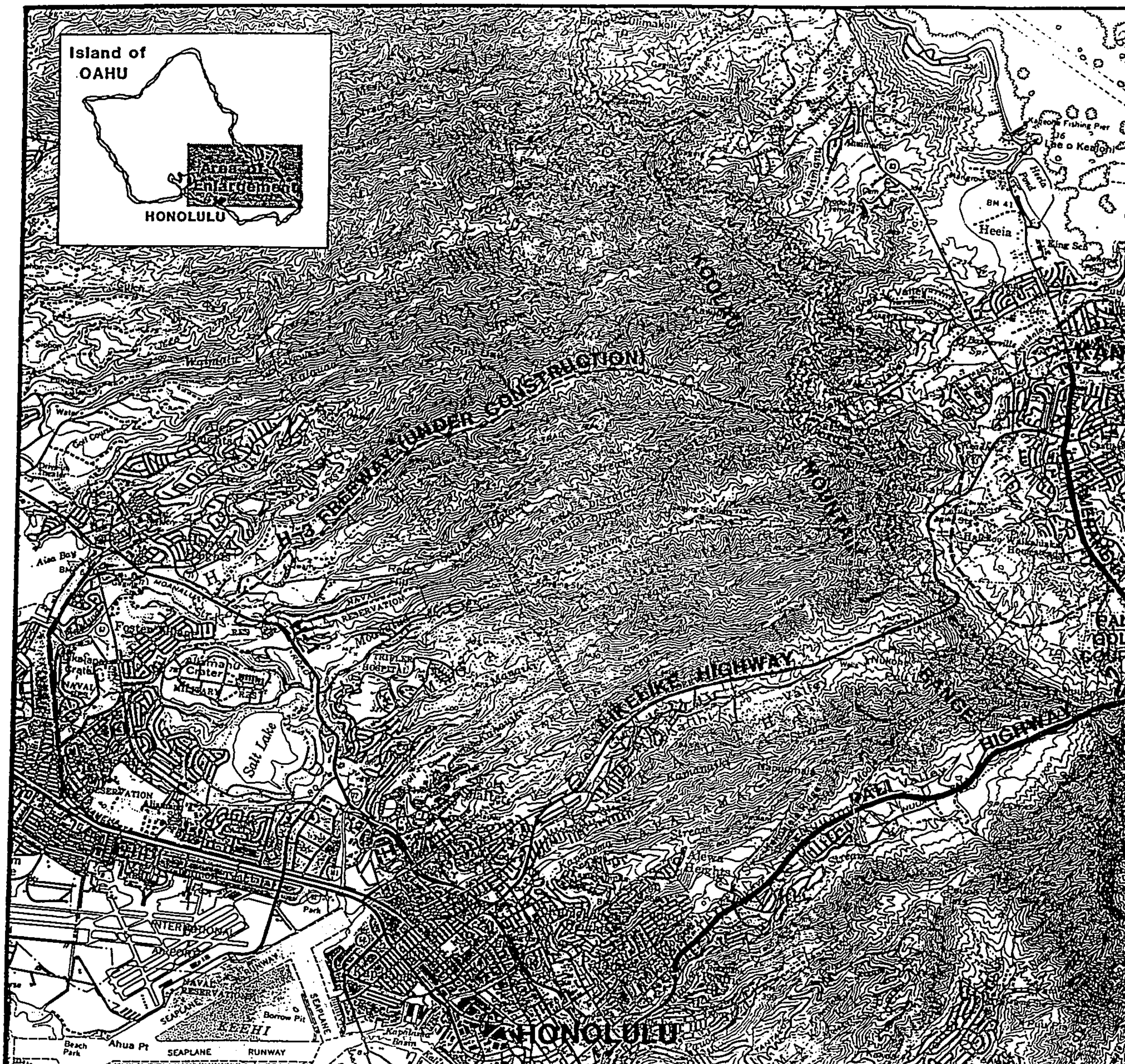

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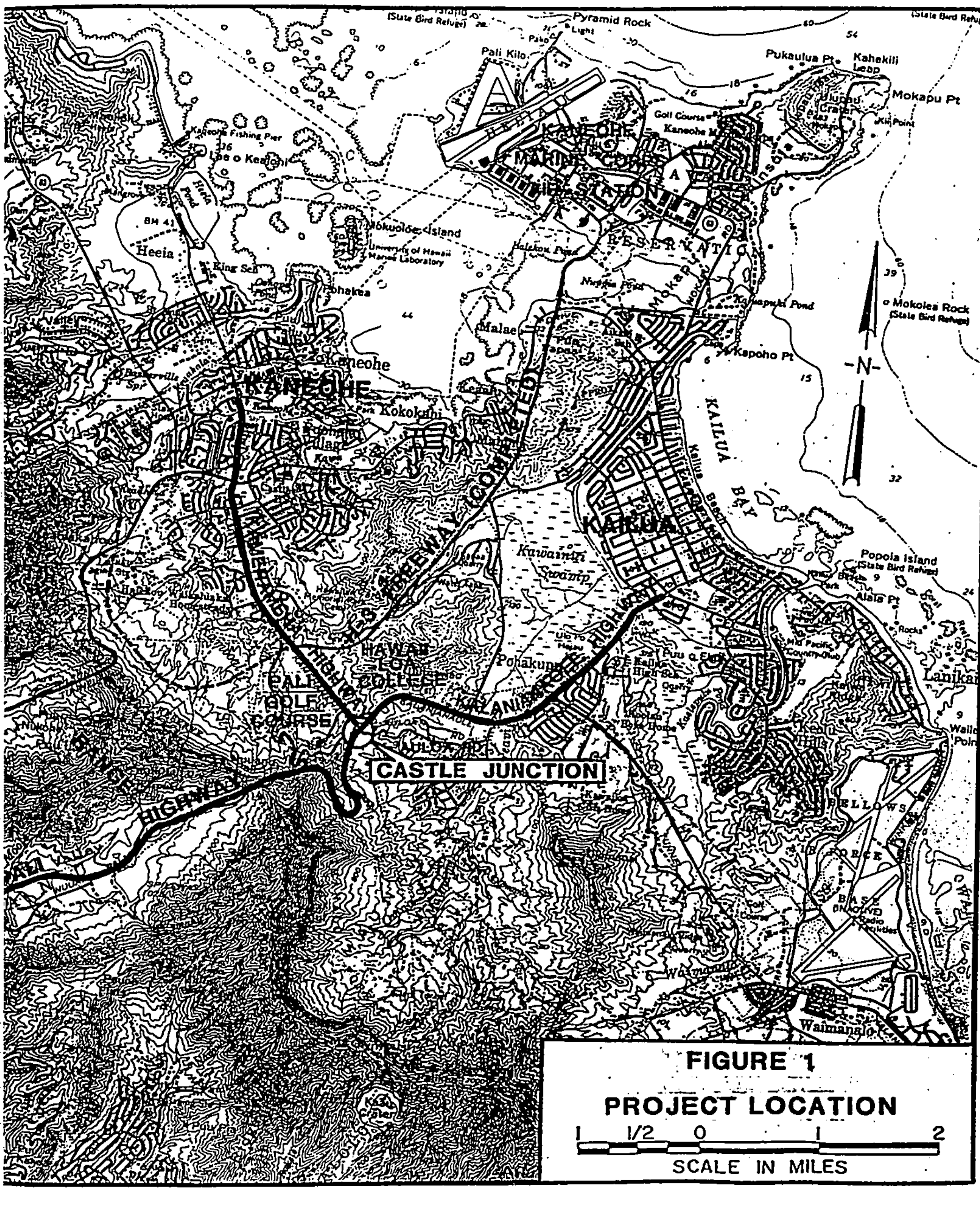


FIGURE 1

PROJECT LOCATION

The proposed interchange would provide improved traffic flow for the safe and efficient transportation of people and goods. The highway junction is expected to remain a major node in the highway system in the foreseeable future. On a regional basis, the proposed project would improve the major link between the residential communities of Kaneohe, Kailua and other windward communities and Honolulu.

(See Appendix A - Traffic Impact Analysis in Volume II for detailed information on current and future traffic projections.)

2.0 ALTERNATIVES

The alternatives discussed in this section are the result of a process involving the development of several conceptual alternatives and then reducing the number of alternatives for further study based on input obtained during a public meeting and discussions with interested agencies.

The primary source of the criteria used to develop the interchange alternatives was the "Hawaii Statewide Uniform Design Manual for Streets and Highways." In addition, the "1985 Highway Capacity Manual" was used to determine the lane requirements needed to accommodate the anticipated traffic volumes for the year 2010.

2.1 ALTERNATIVE A - TRUMPET INTERCHANGE

Alternative A would have a trumpet configuration as shown in Figure 2. The trumpet would be located in the east quadrant. Outbound traffic from Honolulu would have to make a 270 degree turn to travel northbound along Kamehameha Highway. Traffic from Kamehameha Highway to Kalanianaole Highway would have to make a 90 degree turn to the left to travel to Kailua. The remaining right-turn movements to and from Kamehameha Highway would be provided by direct ramps.

Service from Auloa Road to Kaneohe would be provided through the trumpet to Kamehameha Highway. Service from Kamehameha Highway to Auloa Road, however, would not be provided, nor would service to and from Kalanianaole Highway.

Service to and from the Pali Golf Course and Hawaii Loa College would be provided via a signalized intersection at approximately the same location as the existing intersection.

The estimated construction cost for this alternative is $28,500,000; acquisition of miscellaneous remnant parcels is estimated to cost $422,000; and acquisition of additional rights-of-way are estimated to cost $184,000. The total cost would therefore be $29,106,000.

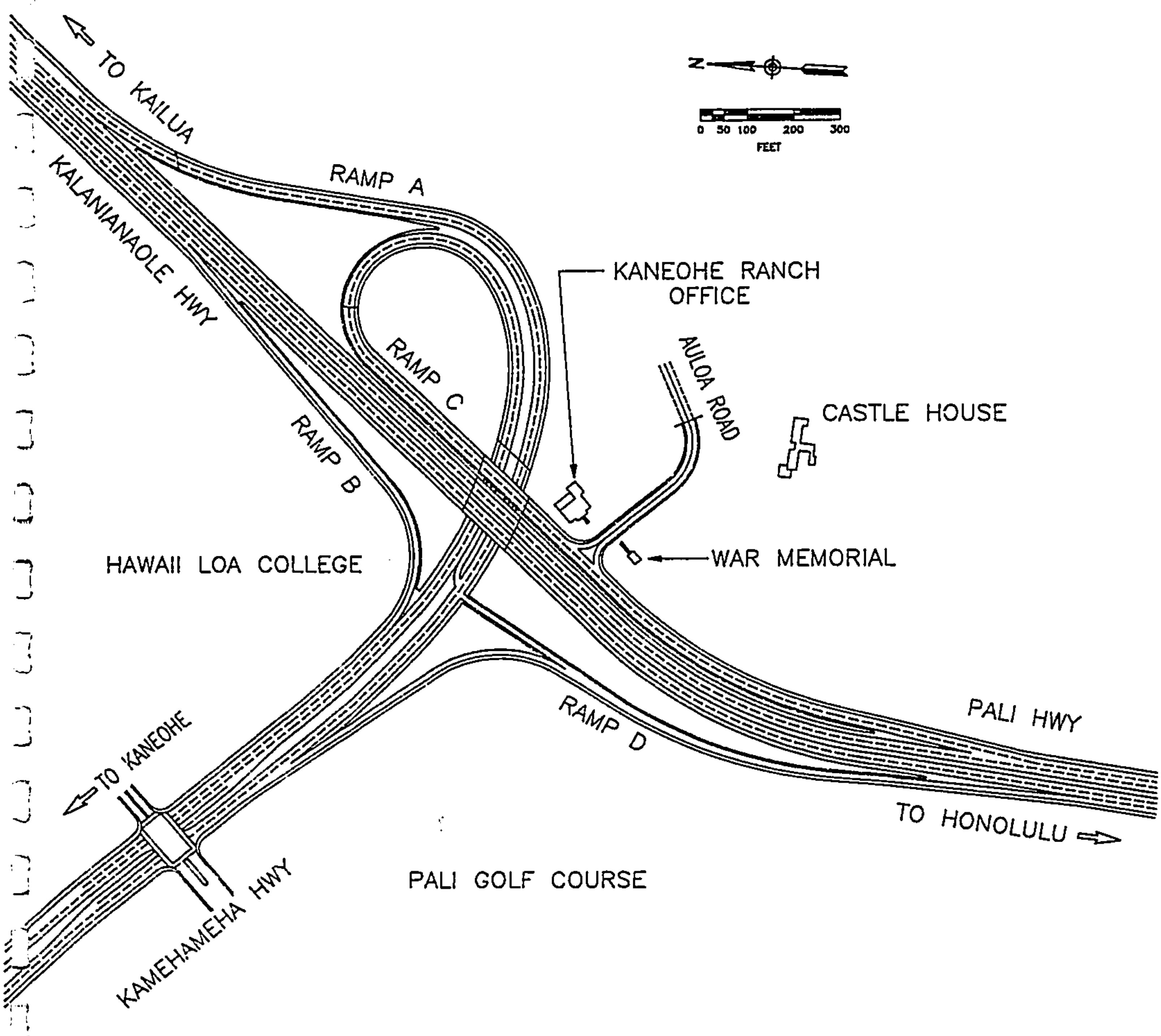


FIGURE 2

ALTERNATIVE A

2.2 ALTERNATIVE B - DIRECTIONAL INTERCHANGE

As shown in Figure 3, all traffic movements to and from the major highways would be provided for by direct ramps. Traffic movements between Auloa Road and Pali Highway would be provided for, however, movements between Auloa Road and Kamehameha and Kalanianaole Highways would not be provided for.

Access to and from the Pali Golf Course and Hawaii Loa College would be provided via a signalized intersection approximately 700 feet north of the existing intersection along Kamehameha Highway. Traffic to and from the Pali Golf Course would use a frontage road on the east (college) side of Kamehameha Highway and an underpass at the location of the existing intersection to access the existing entrance.

The estimated construction cost for this alternative is $27,000,000; acquisition of miscellaneous remnant parcels is estimated to cost $422,000; and acquisition of additional rights-of-way are estimated to cost $113,200. The total cost would therefore be $27,535,200.

2.3 ALTERNATIVE C - FULLY DIRECTIONAL INTERCHANGE

Alternative C is a fully directional interchange (Figure 4). The Pali Highway to Kamehameha Highway movement would be via a two-lane flyover. The remaining movements would be provided for by directional ramps. Access to and from Auloa Road would be via an underpass from north of the Kaneohe Ranch Office to a frontage road parallel to Kamehameha Highway and adjacent to the golf course.

Access to the golf course and Hawaii Loa College would be via a new intersection approximately 700 feet north of the existing intersection. This would provide direct access to the college at the location of a new entrance indicated on the college's master plan. A frontage road would link the new entrance with the roadway at the existing entrance. Traffic to and from the golf course would use the frontage road and an underpass at the location of the existing intersection.

The estimated construction cost for this alternative is $29,000,000; acquisition of miscellaneous remnant parcels is estimated to cost $422,000; and acquisition of additional rights-of-way are estimated to cost $193,200. The total cost would therefore be $29,615,200.

2.4 ALTERNATIVE D - TRANSPORTATION SYSTEM MANAGEMENT

Transportation System Management (TSM) refers to a broad range of potential improvement strategies to more effectively capitalize on existing highway and transit facilities and travel practices to

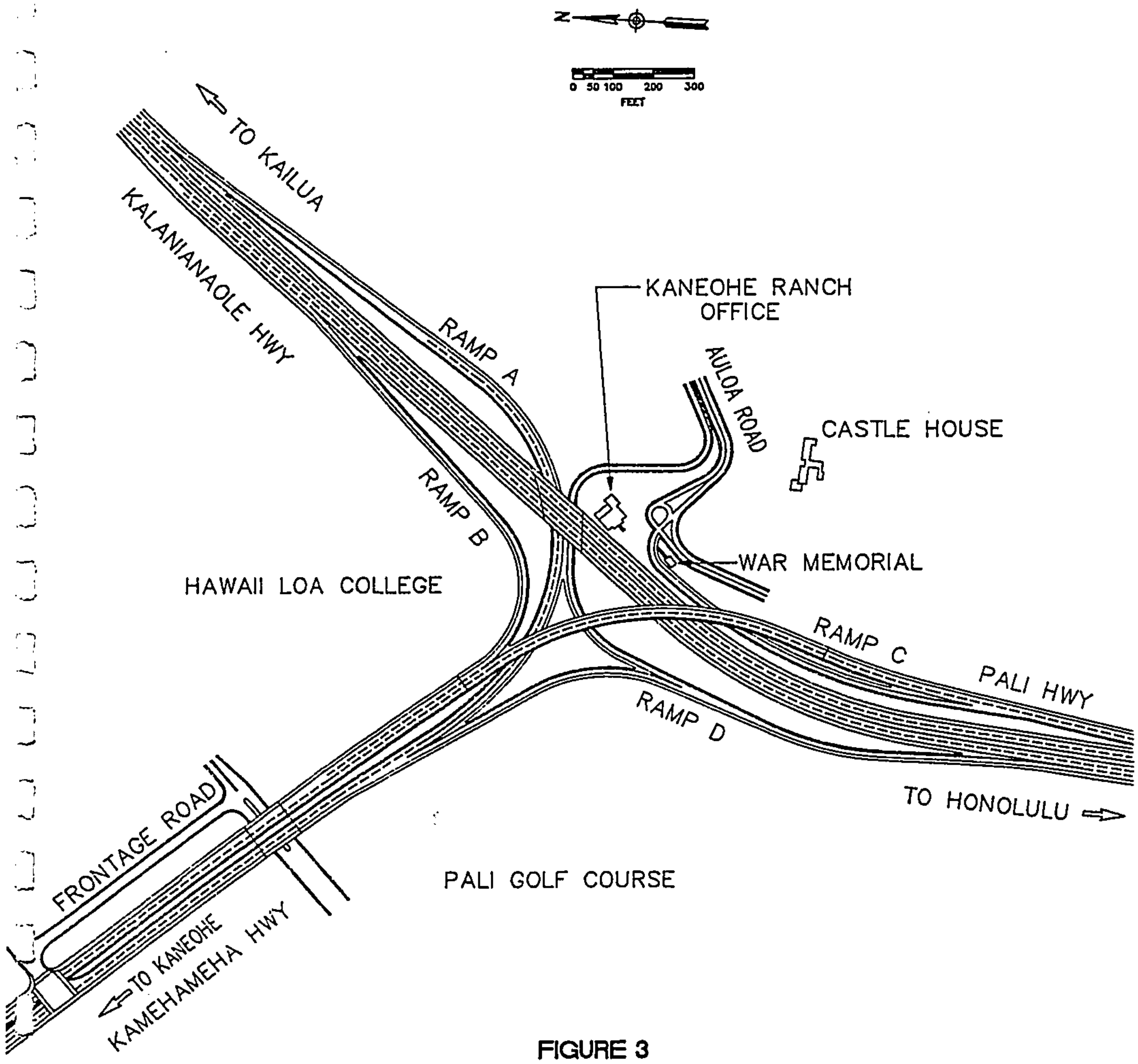


FIGURE 3

ALTERNATIVE B

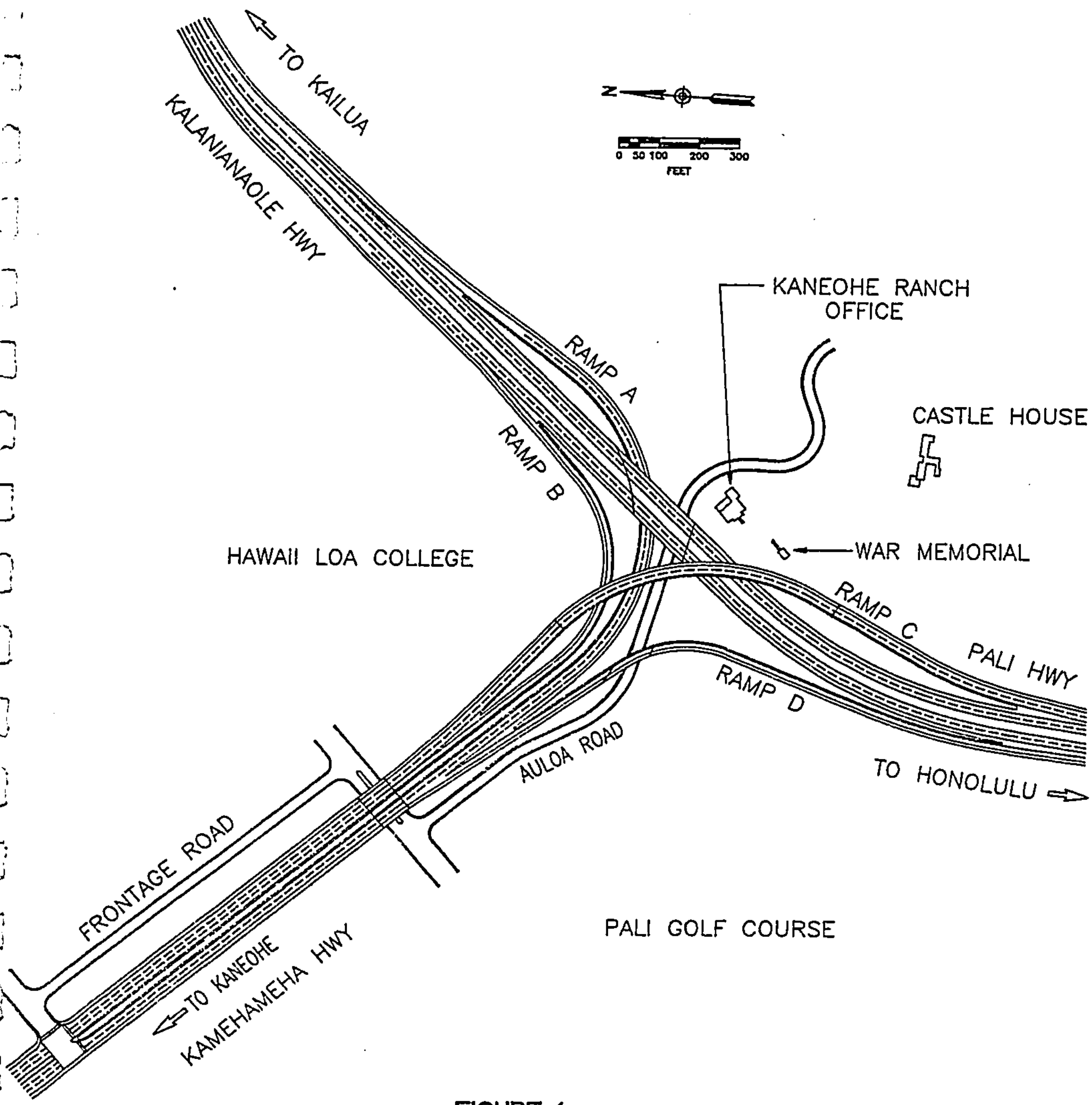


FIGURE 4

ALTERNATIVE C

achieve a broad range of transportation related goals. Typical measures include:

- o Ride-sharing (carpools),
- o Van pools,
- o Public transportation,
- o Flex-time work hours, and
- o Intersection Improvements.

2.5 ALTERNATIVE E - NO-BUILD

Alternative E is the no-build alternative. This alternative assumes that no improvements are initiated at Castle Junction.

2.6 THE PREFERRED ALTERNATIVE

To compare the relative advantages and disadvantages of the interchange alternatives, TSM and no-build, seventeen criteria related to all of the completed engineering and environmental studies were compared. The interchange alternatives provide the improved traffic flow desired; the TSM and no-build alternatives do not. Of the three interchange alternatives, Alternative C, the fully directional interchange, is the preferred alternative, and is being recommended for further design and construction. Alternative C provides a better operating level of service than Alternatives A or B, and provides for all movements to and from Auloa Road. Environmentally, there are no significant differences in impacts among the alternatives.

2.7 TENTATIVE PROJECT SCHEDULE

Begin Final Design..........................	July	1991
Begin ROW Acquisition.......................	January	1992
Complete ROW Acquisition and Final Design....	July	1992
Begin Construction..........................	March	1993
Complete Construction.......................	September	1994

3.0 SUMMARY DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 EXISTING GEOMETRICS

The existing geometrics are illustrated in Figure 5. As shown, the intersection has four legs. The north leg is Kalanianaole Highway, which is a four lane, divided state highway. The approach to the intersection has a separate southbound to eastbound left-turn lane and a southbound to westbound right-turn ramp.

The east leg of the intersection is Auloa Road. This roadway is a two-lane county facility serving the residential areas to the east. The approach to Castle Junction is striped for one lane, but it operates as a two-lane approach as the drivers use the left lane as a through and left-turn lane and the right lane as a right-turn only lane.

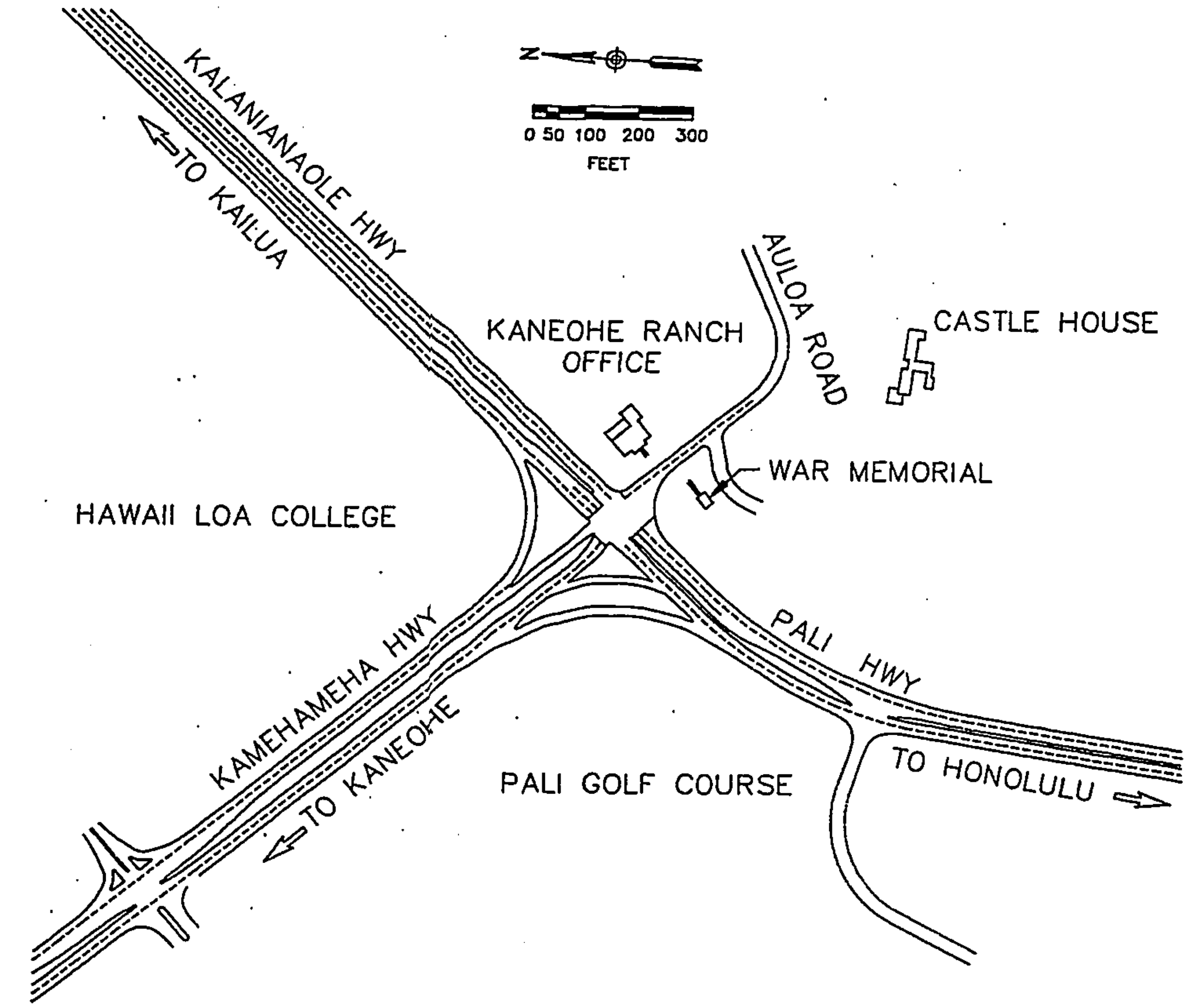


FIGURE 5

EXISTING CONFIGURATION

The south leg of the intersection is Pali Highway. Pali Highway is a four-lane divided state highway linking the northeast side of the island with Honolulu. The approach to Castle Junction is two through lanes and one left-turn lane. Right turns are allowed from the right through lane. Of particular concern is the downgrade of Pali Highway as it approaches Castle Junction. The gradient is 6.50 percent. Because of this, relatively long stopping sight distances and lengths of acceleration and deceleration lanes are required.

The fourth and final leg is Kamehameha Highway, which is a four-lane divided state highway. The intersection approach is two left-turn lanes and a channelized right-turn lane. Through movements are allowed from the right left-turn lane. Recently, an additional right-turn lane was installed to accommodate Honolulu bound traffic. This lane operates during the morning peak period only.

The entrances to the Pali Golf Course and Hawaii Loa College are located approximately 1000 feet west of Castle Junction. Separate left-turn lanes are provided along Kamehameha Highway at these entrances.

Castle Junction currently is signalized. The signals provide separate left-turn phasing along the northbound and southbound approaches, and separate phases for the eastbound and westbound approaches.

The intersection of Kamehameha Highway and the college/golf course entrance is unsignalized.

3.2 TOPOGRAPHY AND DRAINAGE

The intersection occupies a low spot or saddle in the Oneawa Ridge which runs southwest from Ulumawao Peak towards the central core of the Koolau Mountains (Figure 6). As such the project site straddles the boundaries of two drainage basins. The intersection sits at the head of a deep valley to the east-northeast that drains a portion of the project area into Kahanaiki Stream. A lower ridge runs eastward from the intersection along the south side of Auloa Road. To the west of the intersection is a gently sloped area (covered mostly by golf course) terminating at Hawaii Loa College against the mass of Ulumawao Peak. Surface drainage from this portion of the site flows into a basin on the Hawaii Loa College campus running northwest, roughly parallel to and near Kamehameha Highway, as part of the Kamooalii Stream Watershed. Surface drainage from the golf course flows through culverts beneath Kamehameha Highway into this basin.

Drainage culverts run beneath portions of all three highways. The most substantial are two 8'x11' box culverts beneath Kamehameha Highway.

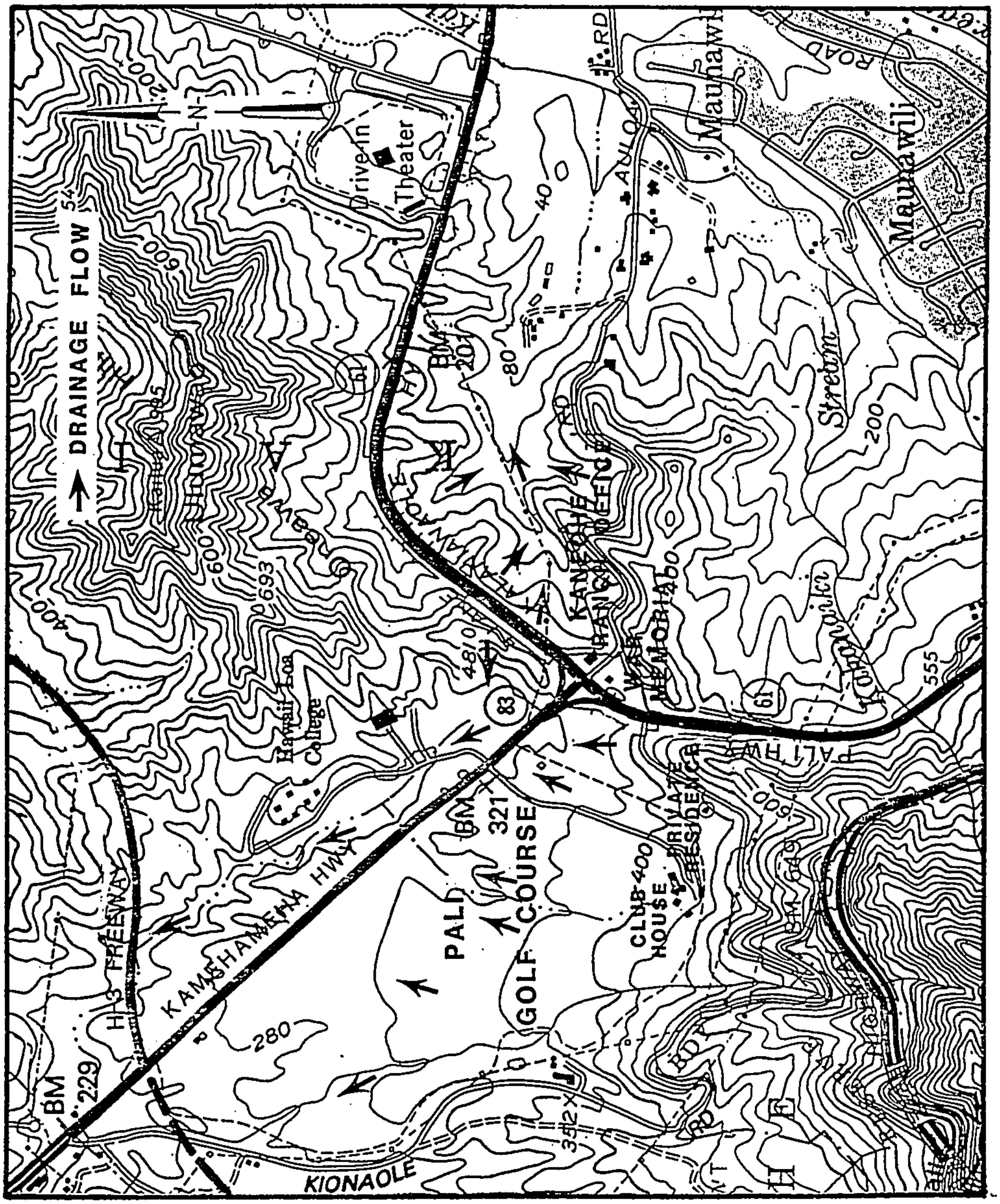


FIGURE 6
GENERAL TOPOGRAPHY

Construction of the existing highways resulted in steep cut and fill slopes in three of the four quadrants. Dramatic benched cuts more than 50 feet high exist along the northwest side of Kalanianaole Highway. These cuts and associated steep slopes have large unvegetated areas and present significant erosion problems. In periods of high rains, debris often accumulates on Kalanianaole Highway, exacerbating traffic congestion and posing threats to motorists.

3.3 SOILS

Geologic surface areas at and near the site include weathered rock associated with the steep slopes of the bluff and deep valley to the north and east which consists of Alaeloa and Helemano soil series. These soils are considered to have moderate to severe potential for erosion. The gently sloping area to the west is older alluvium consisting of Kaneohe series. The younger alluvium in the bottom of drainage ways consists of Hanalei series (U.S Dept. of Agriculture, 1972).

3.4 HYDROLOGY AND WATER QUALITY

No perennial streams occur within the project site. The nearest stream to the northwest is Kamooalii which originates at the base of the Koolaus and joins Kaneohe Stream at the Kaneohe Flood Control Project Dam (Hoomaluhia Park). The drainage basin running through Hawaii Loa College joins Kamooalii Stream after passing through culverts at Halekou Interchange (H-3 and Kamehameha Highway) approximately 1 mile from the site. The nearest stream on the Kailua-side of the project is Kahanaiki which feeds into Kawainui Marsh and eventually joins Maunawili Stream. The gully behind the Kaneohe Ranch Office building joins Kahanaiki stream approximately 1 mile down slope.

Rocks of the Kailua Member of the Koolau Basalt, which occur in the area, are usually so dense that they are essentially impermeable (Takasaki, et al., 1969). As a result, no ground water development exists in the project area. Small amounts of ground water, however, may occur in seeps through joints in the bedrock and at contacts between soil and rock or between dissimilar soils. Such seeps could be of importance to the stability of cut and fill slopes. Should subsurface water be found, either during later subsurface investigations for design of the project or during construction, it should be evaluated relative to its impact on slope stability. (For further information see Appendix C in Volume II.)

3.5 FLORA AND FAUNA

A botanical survey identified three vegetation types in the area: (1) mixed forest; (2) open scrub; and (3) roadside vegetation (Appendix D, Volume II). Almost all of the area is dominated by introduced species, and certain portions appear to have been disturbed at one time or another. A few native species were identified, however, these occur in similar environmental conditions throughout the islands. None are officially listed threatened or endangered species; nor are any candidate or proposed for such status.

A faunal survey of the site indicated that the present environment provides a moderate range of habitats which are utilized by the typical array of exotic birds and mammals one would expect at this elevation and in this type of environment on Oahu (Appendix E).

3.6 *ARCHAEOLOGY AND HISTORIC SITES*

An archaeological reconnaissance of the project area revealed no prehistoric sites or cultural layers and no significant historic sites other than the Kaneohe Ranch Office and War Memorial Boulder (Appendix G, Volume II). A few minor recent historic features believed to be remnants of U.S. Army Camp Pali were observed.

Evidence from historical sources and from neighboring archaeological studies suggest that there was probably little traditional Hawaiian utilization of this immediate area. Background research shows that the area was massively impacted by ranching, pineapple cultivation, and the stationing of at least 1,000 soldiers at Camp Pali (in 1945) which included the north portion of the project area. The presence on the grounds of Hawaii Loa College of unexploded ordinance dating to the occupation of Camp Pali has been noted. While no ordinance was observed in the archaeological field work, the possibility exists that some will be encountered in the vicinity in the future.

The State Department of Land and Natural Resources (DLNR) has determined that the War Memorial Boulder is not a historic site and/or State Park covered by provisions of Section 4(f) of the Department of Transportation Act.

The Kaneohe Ranch Office building was placed on the State and National Registers of Historic Places in 1983 as Site number 80-10-1360. Because it is in view of nearly everyone coming over the Pali Highway, it is considered to be a major landmark on the windward side of Oahu. Architecturally it is of exceptional significance because it is one of the latest known examples of Hawaiian style architecture. Built in 1941, it has received international awards. It is of historical significance because of its close associations with Kaneohe Ranch, which has been a major force guiding the history of the Kaneohe and Kailua districts during the past ninety years.

3.7 LAND USE AND DEVELOPMENT PLANS

Land uses in the immediate area include: a private residence along the remanent portion of old Pali Road adjacent to the golf course lands, with access directly to and from the Pali Highway; Pali Golf Course, a municipally owned pubic golf course to the west (see section 3.8 below); Hawaii Loa College to the northwest; and the Kaneohe Ranch Office to the east (Figure 6).

The remanent portion of old Pali Road also provides access to Pali Highway from Kionaole Road, however, Kionaole Road has been closed to public access by the City and County of Honolulu.

All land in the area is classified under the State Land Use Law as Conservation and is under the jurisdiction of the State of Hawaii Board of Land and Natural Resources. A special subzone has been established for the Hawaii Loa College land parcel. The objective of the subzone is to provide for areas possessing unique developmental qualities which complement natural resources. All other adjacent lands are within the General subzone, with the objective to designate open space where specific conservation uses may not be defined, but where urban use would be premature.

The City and County General Plan describes the area as "urban fringe" (for Kailua and Kaneohe) and "rural" (for Waimanalo and Kahaluu-Kualoa), and indicates that the existing suburban and agricultural character of the community is to be maintained. The General Plan policy is to manage physical growth and development in the urban-fringe areas so that an undesirable spreading of development is prevented and their proportion of the island-wide resident population remains unchanged.

The site is in the area covered by the Koolaupoko Development Plan of the City and County of Honolulu. The Development Plan's Public Facilities Map, adopted in 1983, shows an interchange at the site with construction to begin within six years from the date of adoption.

3.8 RECREATIONAL LANDS

The Pali Golf Course, a public 18-hole golf course with club-house and driving range facilities, is adjacent to the existing highway right-of-way to the west of the intersection. It is owned by and under the jurisdiction of the City and County of Honolulu. It is the third heaviest played course on the island and one of four municipally operated. Access is by vehicle through the entrance located on Kamehameha Highway. Currently, there is no signal at the intersection which at times makes ingress and egress difficult and dangerous. Lands on the Castle Junction-side of the access road are currently unused except for a practice tee area.

3.9 AESTHETICS/VIEWS

Steep slopes, bluffs, and gullies provide dramatic topographical relief in the immediate project area. Steep cuts exist on three of the four quadrants. Existing slopes in the north quadrant have sparse or no vegetative covering, as steepness inhibits plants from taking hold. Roadsides are vegetated with a weedy assemblage of species, usually annuals. Gullies and bluffs support a mixed forest of various tree and shrub species. Many of the features associated with the project site have been altered at one time or another.

Makai views from the project area are limited due to topographical features, however, a panoramic view of the Koolaus does exist to the south, west and northwest. This vista is limited to traffic in the immediate intersection area.

The project area is not visible in the panoramic views of Kailua and Kaneohe from the Pali Highway except for one scenic pulloff along southbound lanes above the site. It is also shielded from all views at the Pali Lookout except those at the far eastern edge.

4.0 IMPACTS AND MITIGATION MEASURES

4.1 AIR QUALITY

Table 1 shows air quality data in Honolulu and Waikiki, obtained from State of Hawaii Department of Health monitoring stations. The data indicate general compliance with state and federal ambient air quality standards. Carbon monoxide was the only pollutant exceeding state standards during the period of 1985-1987, and it was in excess on only one day at Honolulu in 1987. Because the project area is in a more rural setting than these monitoring stations, it is considered unlikely that the air quality there would be worse than that at the Honolulu or Waikiki stations. (For further discussion see Appendix F, Volume II.)

Because the project is expected to change the traffic flow rate, not the total volume, total emissions are expected to remain the same or decrease due to more efficient traffic movement.

Caline4, a dispersion model for predicting air pollutant concentrations, was used to determine the effect of the project on ambient carbon monoxide concentrations (Appendix F, Volume II). The results of the dispersion modeling studies are presented in Table 2. These results represent the maximum predicted concentrations at three receptors located near the intersection at the Kaneohe Ranch Office, the Castle House and the War Memorial.

Comparison of these results to state ambient air quality standards shows that maximum concentrations at none of the receptors exceed

TABLE 1

SUMMARY OF AIR QUALITY DATA 1985-1987

POLLUTANT	WAIMANALO			HONOLULU			WAIKIKI		
	1985	1986	1987	1985	1986	1987	1985	1986	1987
TOTAL SUSPENDED PARTICLES									
MAXIMUM 24 HOUR AVERAGE ug/m^3 CONCENTRATION	52	72	45	48	61	59			
DAYS EXCEEDING STATE STANDARD	0	0	0	0	0	0			
SULFUR DIOXIDE									
MAXIMUM 24 HOUR ug/m^3 CONCENTRATION				<5	6	11			
DAYS EXCEEDING STATE STANDARD				0	0	0			
CARBON MONOXIDE									
MAXIMUM 1 HOUR ug/m^3 CONCENTRATION				10.4	13.5	11.1	14.4	9.0	8.3
DAYS EXCEEDING STATE STANDARD				1	3	1	6	0	0
LEAD									
MAXIMUM QUARTERLY AVERAGE ug/m^3 CONCENTRATION				0.1	0.1	0.0			
DAYS EXCEEDING STATE STANDARD				0	0	0			

state standards for CO for the existing situation or any of the options for any year evaluated. The predicted CO levels for all three project alternatives are significantly lower than the existing, or no-build option. The general trend of lower curbside concentrations predicted for years further into the future is due to expected advances in vehicular efficiency.

The impacts associated with the operation of this project are beneficial, due to improved traffic flow and improved vehicular efficiency, therefore mitigation measures are not necessary.

TABLE 2
MAXIMUM CURBSIDE CARBON MONOXIDE CONCENTRATIONS

ALTERNATIVE/YEAR	CO CONCENTRATION, mg/m^3 KANEOHE RANCH	CASTLE HOUSE	WAR MEMORIAL
Existing 1988	1.7	0.7	1.1
Existing 1995	1.3	0.6	1.3
Existing 2010	1.0	0.5	1.1
Alternative A 1995	0.5	0.3	0.5
Alternative A 2010	0.5	0.3	0.3
Alternative B 1995	1.1	0.3	1.1
Alternative B 2010	0.5	0.2	0.3
Alternative C 1995	0.7	0.5	0.7
Alternative C 2010	0.7	0.3	0.7

4.2 NOISE

The sound level descriptor used in this report is the hourly energy equivalent sound level (Leq) which considers the combined effects of all noises near and far and includes background noise and noise fluctuations. Leq is defined as the continuous A-weighted sound level that in a specified period of time contains the same sound energy as the actual time-varying sound during that period. It is a particularly stable and predictable unit for the description of traffic noise and, and at the same time, is well-correlated to people's reaction to noise.

A site visit was conducted in June 1989 to identify representative sensitive receptor locations and to conduct background noise measurements (Appendix B, Volume II). Measured Leq levels north of Kamehameha Highway near Hawaii Loa college entrance were 67 and 68 dBA during AM and PM peak traffic noise hours, respectively. Measured Leq levels near the Kaneohe Ranch Office were 73 and 74 dBA during AM and PM peak traffic noise hours, respectively.

Noise impacts from the no-build and Alternative C cases were evaluated at six sensitive receptor locations. Alternative C was analyzed in detail because this alternative would have the worst noise impact. The highest levels obtained from the traffic noise prediction model analyses for the design year (2010) are presented in Table 3. Predicted noise levels vary between 55 and 72 dBA for the no-build case and between 55 and 70 dBA for Alternative C.

Based on the Noise Abatement Criteria established by the FHWA, the results of the noise analysis indicate that noise mitigation measures are not required for existing College buildings, the proposed college president's home, Castle house, and golf course. Noise levels would be 72 dBA at the Kaneohe Ranch Office for the no-build case, but it would be reduced to 70 dBA for Alternative C. Because this historic building is used as an office, no noise mitigation is required.

4.3 UTILITIES AND PUBLIC SERVICES

Electrical transmission lines (46KV) cross over Kalanianaole Highway, running from the bottom of the deep valley in the northeast quadrant to the top of the cut just northwest of Kalanianaole Highway and then crossing and running along the mauka side of Kamehameha Highway to the Hoomaluhia substation.

Depending on the alternative chosen and location of utility easements the 46KV electrical transmission lines may have to be relocated. Discussions with Hawaiian Electric Company indicate that no users would be affected by any possible relocation of the lines.

Bus stops are currently located on north and south bound lanes of the Pali Highway at Castle Junction and also on both sides of Kamehameha Highway at the Hawaii Loa/Pali Golf Course intersection. Bus routes serving these two intersections are trans-Koolau, running from Kailua to Honolulu (56 and 57) and Kaneohe to Honolulu (55), respectively. Route 77 travels between Waimanalo and Kaneohe along Kalanianaole and Kamehameha Highways. Certain trips require walking between the intersections to transfer routes, and, depending on the route, crossing Pali Highway. There currently are cross walks at both intersections and a cement sidewalk running down the median of Kamehameha Highway.

The two stops along Pali Highway would not be allowed due to requirements of the controlled access interchange design. The cross walks at Castle Junction and sidewalk would also be eliminated. To assist in the determination of potential impacts to bus riders, the Bus Systems Division of the City and County of

TABLE 3
CASTLE JUNCTION TRAFFIC NOISE PREDICTION

RECEPTOR NO.	LAND USE	NOISE CRITERIA dBA	EXISTING NOISE LEVELS dBA	DESIGN YEAR (2010) PEAK HOUR NOISE LEVELS, Leq(h), dBA	
				NO BUILD	ALTERNATIVE C
1	EXISTING COLLEGE	67	68 (M)	55	55
2	COLLEGE PRESIDENT'S HOME	67	59 (E)	57	56
3	KANEOHE RANCH OFFICE	72	74 (M)	72	70
4	CASTLE HOUSE	67	58 (E)	60	59
5	GOLF COURSE	72	64 (E)	62	60
6	FUTURE COLLEGE	67	60 (E)	61	60

NOTES:
(M) Measured noise level.
(E) Estimated based on measurements at a similar location.

Honolulu Department of Transportation Systems conducted a survey of passengers getting on or off at all four stops during a typical weekday.

- o Pali Highway - northbound. Routes impacted include 56 and 57. Three people got off, seven got on during the 12 hour count. Those getting off were likely walking to the college, the golf course or the Kamehameha stop to transfer to Kaneohe. Those boarding were likely going to Kailua or Waimanalo. The level of use of this stop does not justify diverting the bus onto Kamehameha Highway to make a stop. The same connections may be made to route 77, the college, golf course and Kaneohe from the next northbound stop at Maunawili Road or at Castle Hospital, and this would constitute adequate mitigation.

- o Pali Highway - southbound. During the 12 hour survey, one person got on and 18 off. The same analysis would apply to this stop as to the northbound stop. There is not enough usage to justify diverting the bus. By utilizing route 77 and transferring at stops to the north of the project area, all necessary movements may be accommodated.

- o Kamehameha Highway - westbound. Routes impacted include 55 and 77. At this stop, in front of the college, 45 people got on and 24 got off. This stop would have to be moved, probably onto the frontage road, but would be maintained.

- o Kamehameha Highway - eastbound. At this stop, in front of the golf course, 10 people got on and 66 got off. As for the above stop, the level of usage mandates that the stop be maintained. Fortunately, this stop could also be moved onto the frontage road.

4.4 EROSION, SEDIMENTATION AND WATER QUALITY

None of the interchange alternatives would directly affect any streams, wetlands or water resources in the area. The potential for indirect impacts, by way of increased sedimentation to nearby properties and critical areas such as Kawainui Marsh and Kamooalii Stream is considered low (Appendix H, Volume II). Construction would involve grading the exposed bluff, terracing and landscaping. Reduced slopes, terraced runoff control ditches and increased vegetative cover would reduce existing erosion problems and traffic hazards and would be a long-term beneficial impact.

4.5 FLORA AND FAUNA

Construction would result in the loss of existing vegetation along the proposed highway interchange, but neither the species present nor the communities are of any particular significance. Similarly, despite some loss of habitat, impacts on bird and mammal populations of Windward Oahu would be virtually unmeasurable. Thus, the effect of the project on the flora and fauna of Windward Oahu would be insignificant. According to the U.S. Fish and Wildlife Service there are no listed or proposed endangered or threatened species of plants or animals which are present in the vicinity of, or would be affected by the project (Kramer, 2/23/89).

Areas disturbed by construction activity would be revegetated as soon as possible. Where feasible, it might be desirable to landscape with native plants already found in the area as these species are adapted to the local conditions.

4.6 LAND USE AND NEIGHBORING PROPERTIES

Depending on the alternative selected, varying amounts of land may need to be acquired to expand the existing rights-of-way. It would also be necessary to temporarily use portions of neighboring properties for construction activities. In the event that either permanent or temporary parcel acquisition is necessary, all state and federal laws and regulations, in particular the Highway Surface and Relocation Act of 1987, would be followed in order to ensure that proper notification and other considerations would be given to affected land owners.

Table 4 shows the estimates of land area outside of the existing rights-of-way which would likely be used during construction. None of the acquisitions would involve lands which are currently in active use.

TABLE 4
ADDITIONAL LAND AREA REQUIRED FOR
TEMPORARY USE DURING CONSTRUCTION
(ACRES)

ALTERNATIVE	QUADRANT NORTH	WEST	SOUTH	EAST	TOTAL
A	8.4	2.9	0.8	5.3	17.4
B	3.8	3.5	3.0	3.8	14.1
C	8.6	3.2	1.2	2.2	15.2

Estimates of permanent land acquisition necessary for expansion of rights-of-way under each interchange alternative are shown in Table 5. None of the acquisitions would involve land that is in current active use.

Widening of the right-of-way in the eastern quadrant will require use of some "other important agricultural land" as classified by the State of Hawaii Department of Agriculture (Figure 7). Coordination with the U.S. Department of Agriculture, Soil

Conservation Service has indicated that removal of these relatively small acreages would not have a significant impact on the total agricultural lands on Oahu. No farms are currently in operation on these lands.

TABLE 5
ADDITIONAL LAND AREA REQUIRED FOR
EXPANSION OF RIGHTS-OF-WAY
(ACRES)

	QUADRANT				
ALTERNATIVE	NORTH	WEST	SOUTH	EAST	TOTAL
A	3.6	0.1	0.2	5.2	9.1
B	3.2	0.03	1.8	1.9	6.93
C	4.9	0.0	0.7	1.2	6.8

The proposed interchange alternatives would close access to the Pali Highway from Kionaole Road (through the remanent portion of old Pali Road). This would landlock three parcels of land which are listed below.

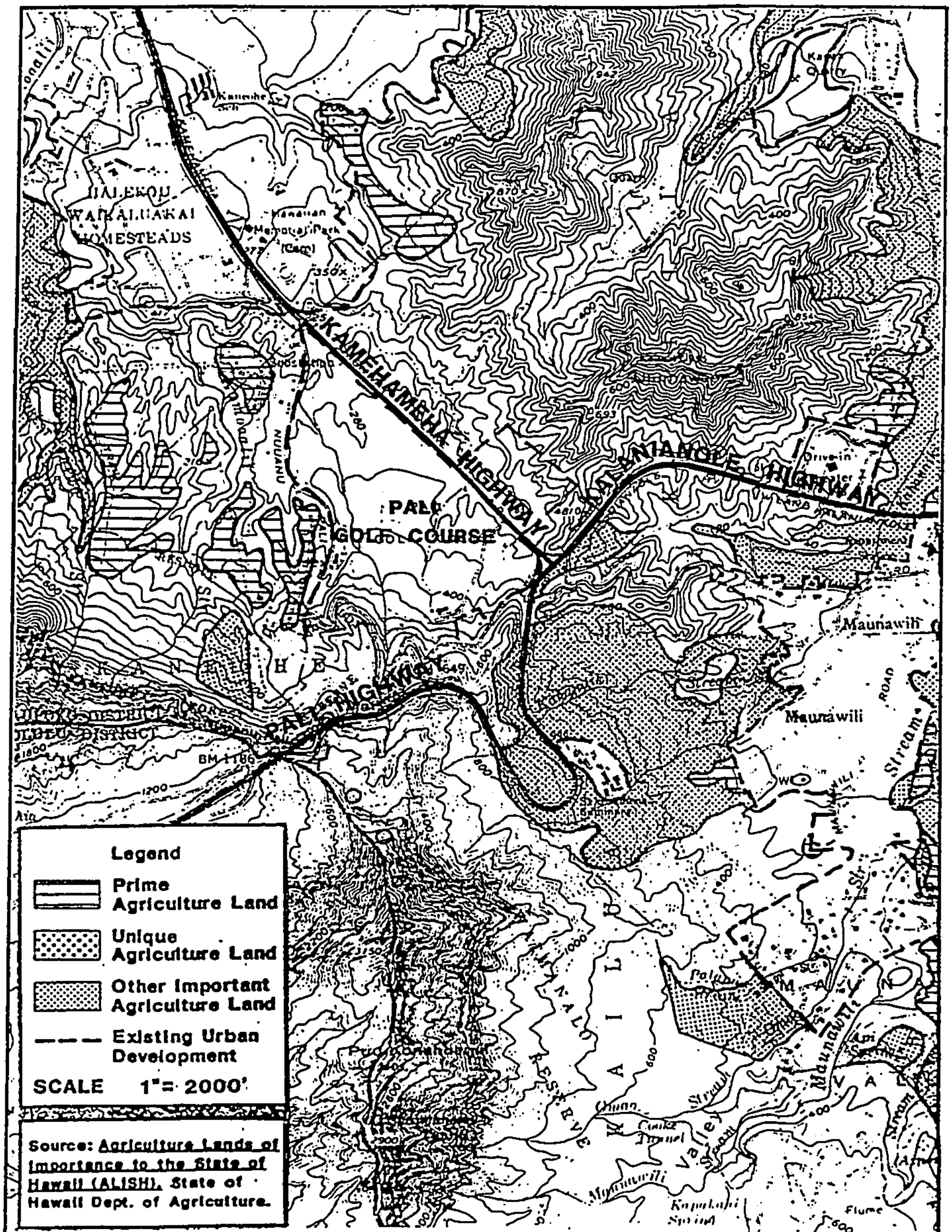
Tax Map Key	Land Area	Building Area	Estimated Damages
4-5-035-006	3.893 acs.	3,016 s.f.	$400,000
4-2-011-019	44.413 acs.	-0-	$ 21,000
4-5-035-004	0.254 acs.	-0-	$ 1,000

The property identified by Tax Map Key 4-2-011-019 has very steep terrain and would be costly to develop. The property identified by Tax Map Key 4-5-035-004 is described by a representative of the land owner as a remanent parcel. The property identified by Tax Map Key 4-5-035-006 contains a single family dwelling.

Two options exist to mitigate the impact to these properties. One is to provide access through the golf course/college intersection by constructing a new road to Kionaole Road. This would involve taking lands from the golf course. The other option would involve state purchase of the properties along with provision of appropriate relocation assistance for residents of the single family residence. Total purchase cost has been preliminarily estimated at $422,000. Purchase of the properties is the preferred course of action due to its cost effectiveness.

All three interchange alternatives involve a signalized intersection for the entrance to the college and golf course, which would improve access.

None of the alternatives would involve relocation of the Kaneohe Ranch Office.



SIGNIFICANT AGRICULTURE LANDS

FIGURE 7

4.7 DEVELOPMENT PLANS

It is generally recognized that provision of new or enlarged public facilities and utilities may contribute to urbanization and growth. However, the Alternatives A, B, and C are not expected to induce significant growth pressures in Windward Oahu communities. These alternatives involve improving traffic flow on existing highways between existing residential communities.

The interchange alternatives are in conformance with development plans of the City and County of Honolulu. The Koolaupoko Pubic Facilities map specifically includes an interchange at the site. The project is also consistent with all applicable sections of the Hawaii State Plan, the State of Hawaii Energy Plan, and the State Transportation Plan. In general these documents promote the efficient, economical, safe, and convenient movement of people and goods.

4.8 RECREATIONAL LANDS

The Pali Golf Course is considered public recreational land under the definitions of Section 4(f) of the Department of Transportation Act. A 4(f) statement (to demonstrate no feasible or prudent alternative to use of the land) would be required if any of the alternatives would impact the golf course. As discussed below, none of the alternatives considered for this proposed project would impact the golf course lands.

No lands from the Pali Golf Course would be acquired for the interchange. Thus, any potential impacts would be confined to those relating to proximity of the project to the site and access.

Air quality and noise impacts of the project are discussed above. These studies do not suggest that there would be any significant impact on golf course lands. In fact, it is likely that improved air quality due to more efficient traffic flow and reduced noise levels would be positive impacts. These effects would be most noticed during morning peak hours when Honolulu bound traffic often backs up to the section of Kamehameha Highway which is closest to actual playing areas (on the Kaneohe side of the access road). Trees and vegetation provide visual buffers and thus minimize visual impacts.

Access to the golf course would not be impaired. Minor traffic related inconveniences may result due to construction activities, however, these would be short lived. All three interchange alternatives have been designed with signalized intersections at the golf course entrance. This is considered an improvement, both in terms of safety and convenience, over the existing situation where some golf course users must exit and enter across traffic on Kamehameha Highway.

Several meetings were held with the City and County of Honolulu Department of Parks and Recreation to keep them informed of progress in alternatives development and selection. A letter from the Director of the Department of Parks and Recreation stating that none of the three interchange alternatives would impact the golf course is included in Appendix K, Volume II.

In sum, it does not appear that the project would significantly impair or reduce the functions of this recreational facility, and therefore, a Section 4(f) statement is not required.

4.9 ARCHAEOLOGY AND HISTORIC SITES

The archaeological reconnaissance for the project area indicated that no further archaeological investigation or monitoring within the project area is required (Appendix G, Volume II). In the unlikely event that cultural remains of any kind, especially human burials, are encountered during construction an archaeologist and the State Historic Preservation Office should be contacted immediately before earthmoving in the vicinity is resumed.

The three interchange alternatives may involve relocation of the War Memorial Boulder. If it is to be moved, it is recommended that proper consideration be made for its relocation and rededication.

The three interchange alternatives do not physically affect the Kaneohe Ranch Office site and do not alter the view of the building from the Pali Highway. Therefore, it does not appear that the project will affect the historical significance of this site. Formal coordination with the State Historic Preservation Officer has been effectuated to comply with the requirements of Section 106 of the National Historic Preservation Act. A copy of the coordination letter is included in Appendix K.

4.10 SOCIO-ECONOMIC

Long term beneficial impacts would include savings of valuable commuter time and increased traffic safety. Also, eliminating "stop and go" conditions during peak flows would result in energy savings as vehicles would operate more efficiently.

It is intuitive that the alternative with the least average driver delay (Alternative C) would result in the least cost to drivers. Alternative D (no-build) would result in the longest average vehicle delays and therefore result in the highest user costs.

4.11 AESTHETICS/VIEWS

Interchange construction would require clearing and grubbing, with cuts and fills creating short-term unsightly conditions. In the long-term, the goal is to create a functional and aesthetically attractive highway interchange. Graded slopes would be landscaped with appropriate ground cover and plantings to improve the aesthetic qualities of the area. The proposed grading would flatten some of the existing steep slopes and make them more suitable for plantings.

Architectural services would be used to aid in the aesthetic design of the interchange elements such as walls, roadway structures and landscaping.

Views from within the project area would not be significantly impacted by interchange construction. Grading of the exposed bluff to the immediate north of the intersection would expand the panoramic view of the Koolaus to the northwest for those traveling southbound on Kalanianaole Highway. The overpass from Pali Highway to Kamehameha Highway provided for in Alternatives B and C would briefly interrupt the southern view of the Koolaus.

The interchange alternatives would not impact significant views in the area because topography shields the project site. Most views from the college grounds would not be impacted. The Pali Highway would only be seen from the third floor of the library. Kamehameha Highway would be more visible, especially in Alternatives B and C where it would be raised from its current elevation, but impacts could be reduced by planting trees along the highway. (For further discussion and sketches see Appendix I, Volume II.)

4.12 CONSTRUCTION RELATED IMPACTS

4.12.1 AIR

Emissions during construction would be generated from ground preparation activities and exhaust emissions from construction machinery. In order to quantify exhaust emissions, the construction and machinery mobilization schedules for the project are required. Because this schedule is not yet available, construction impacts are evaluated using an estimated composite of construction machinery and an assumed work schedule. Monthly construction emissions are estimated using Environmental Protection Agency (EPA) emission factors and are presented in Table 6.

The emission factor developed by EPA provides a monthly estimate of 1.2 tons per acre of fugitive particulate emissions from ground preparation activities. For an assumed project area of 4 acres, fugitive dust emissions would total 4.8 tons per month.

The impacts of construction machinery exhaust should be minimized by keeping all equipment properly tuned and properly maintained as well as minimizing unnecessary idle time. To reduce fugitive dust emissions, all exposed surfaces should be kept well watered and all vehicles leaving the site should be washed to prevent dirt from being carried onto adjacent streets. Coordination of all surfacing activities (concrete pouring and paving) with grading and excavation activities is recommended in order to minimize exposed soil and fugitive dust.

TABLE 6
MONTHLY CONSTRUCTION MACHINERY EXHAUST EMISSIONS

Equipment	Number of Units	Emission, lbs/month CO	HC	NO_x	SO_x	TSP
Grader	1	30	8	11	17	12
Bulldozer	3	1080	114	2496	324	153
Loader	2	52	100	756	73	68
Backhoe	1	135	31	338	29	28
Dump truck	3	138	48	285	54	54
Fork lift	2	270	61	676	57	56
Crane	1	135	31	338	114	28
Cement truck	6	138	48	285	54	54

4.12.2 NOISE

The operation of construction equipment will raise noise levels in the project vicinity. A permit would be required from the State of Hawaii Department of Health to operate construction equipment, vehicles and power tools which operate in excess of the noise limits. Construction equipment and on-site vehicles or devices requiring an exhaust of gas or air would have to be equipped with mufflers. In addition, all construction related vehicles traveling upon city streets and roadways must meet the vehicle noise level requirements set by the State.

4.12.3 WATER QUALITY

Potential erosion problems due to soils exposed during construction would be reduced by adherence to City and County grading ordinances which require approval by the Department of Public Works of plans and procedures for soil erosion controls. Adequate controls would be incorporated on-site, at the potential source of any problems associated with construction. Prompt revegetation and landscaping of the site would provide short-term and long-term protection.

Construction would also involve temporary destruction of drainage culverts beneath portions of all three highways. Proper construction staging would reduce the severity of problems which could occur. The preferred alternative, when chosen, would be designed to meet applicable drainage standards and would include replacement or necessary additions to subsurface culverts. Standards and criteria would be established using DOT, ASSHTO, and other design guides.

4.12.4 SOCIO-ECONOMIC

Design and construction of an interchange would create short-term benefits by providing a temporary source of jobs.

Construction would also entail short-term adverse impacts by temporarily disrupting traffic. This was considered in the development of the alternatives. If Alternative A, B, or C is selected, the three north-bound lanes should be constructed during the initial phase. The existing northbound lane east of the center line could then be utilized to provide a total of four lanes, which would equal existing conditions, during the second phase of construction. Even though the number of lanes would be equal to the existing conditions, traffic would be slower and more congested due to the construction activity. This, of course would mean a lower level-of-service temporarily.

Construction traffic (trucks, earth moving equipment, etc.) would have to be provided for as would a construction site office. The equipment would interfere with traffic movement, especially during the morning inbound peak hour.

Construction related traffic impacts could be minimized by limiting construction to off-peak hours. The peak hours would then only be affected by the reduction in the level-of-service.

5.0 LIST OF AGENCIES CONSULTED

The following agencies, organizations and individuals were consulted in preparation of the EA.

FEDERAL AGENCIES

Fish and Wildlife Service
Soil Conservation Service
Geological Survey

STATE AGENCIES

Department of Health
Department of Land and Natural Resources
Department of Transportation
Office of Environmental Quality Control
Office of State Planning

CITY AND COUNTY OF HONOLULU

Department of Land Utilization
Department of Parks and Recreation
Department of Public Works
Department of Transportation Services

OTHERS

Marvin Anderson	Hawaii Loa College
Carol Kotzen	Hawaii Loa College
John Marvel	Hawaii Loa College
Edward Iida	Belt Collins & Associates
Milton Iseri	Hawaiian Electric Company
Randolph Moore	Kaneohe Ranch (Castle Estate)
Henry Wong	private property owner

6.0 PUBLIC INFORMATIONAL MEETINGS AND PUBLIC HEARING

The State Highways Division conducted public informational meetings on June 19, 1989 and May 15, 1990 for the purpose of:

- Informing the public of the Department of Transportation's plans;
- Identifying those who may have specific inputs and /or particular perspectives of value to the planning process; and
- receiving input and recommendations for evaluation in the development of the proposed project.

On August 28, 1990 a formal public hearing was held to present the Department's preferred alternative and receive testimony from interested parties.

Summaries of the meetings and hearing are provided in the Technical Reference Document, Appendix J.

7.0 LIST OF REFERENCES

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CASTLE JUNCTION INTERCHANGE

City and County of Honolulu, Hawaii

Project No. RF-061-1(17)

Volume 2

TECHNICAL REFERENCE

Negative Declaration
and
Finding of No Significant Impact (FONSI)

Environmental Assessment

Negative Declaration
and
Finding of No Significant Impact (FONSI)

CASTLE JUNCTION INTERCHANGE

City and County of Honolulu, Hawaii

Project No. RF-061-1(17)

Volume 2

TECHNICAL REFERENCE

Negative Declaration
and
Finding of No Significant Impact (FONSI)

Submitted Pursuant to 42 USC 4332(2)(c)
and
Chapter 343, Hawaii Revised Statutes (HRS)

Proposing Agency:

State of Hawaii Department of Transportation
Highways Division

In Cooperation With:

U.S. Department of Transportation
Federal Highway Administration

Accepting Authority:

Governor, State of Hawaii
as delegated to
Office of Environmental Quality Control

TABLE OF CONTENTS (continued)

Appendix A

TRAFFIC IMPACT ANALYSIS

CASTLE JUNCTION INTERCHANGE TRAFFIC STUDY

INTERSECTION OF FAP ROUTE 61
(PALI HIGHWAY - KALANIANAOLE HIGHWAY)
FAP ROUTE 83
(KAMEHAMEHA HIGHWAY)
AND AULOA ROAD

ISLAND OF OAHU, HAWAII

Prepared For

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION

Prepared By

PARSONS HAWAII
BARTON-ASCHMAN ASSOCIATES
Honolulu, Hawaii

April 1990

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1.

INTRODUCTION

Parsons Hawaii (PH) has been retained by the Hawaii Department of Transportation (HDOT) to prepare a conceptual design and an environmental analysis for a proposed improvement of the intersection of Pali Highway at Kamehameha Highway and Kalanianaole Highway, also known as Castle Junction. Development of the interchange design alternatives was subcontracted to Barton-Aschman Associates. As part of this process, a number of steps have been followed relating to the traffic analyses and the development and selection of alternatives. This report presents the data, assumptions and conclusions of the traffic analysis and the development and selection of final alternatives. It is intended to be a stand-alone document providing the information needed to prepare the environmental documents.

PROJECT LOCATION

The location of the project is on northeast side of Oahu (Windward Oahu) and is the first intersection north of the Pali Tunnels, as shown in Figure 1.

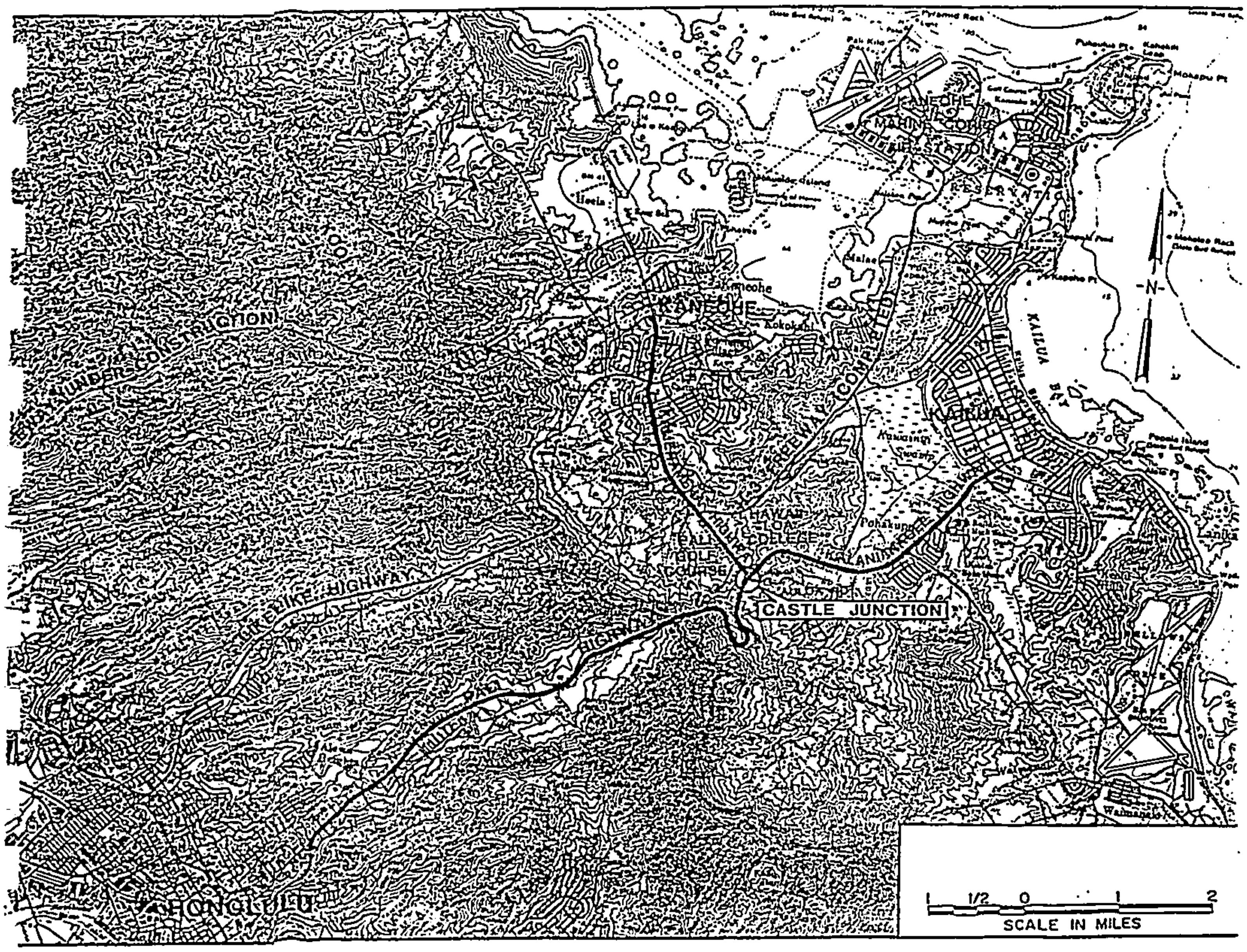


FIGURE 1
PROJECT LOCATION
Castle Junction Interchange Traffic Study

Barton-Aschman Associates, Inc.

The intersection is the focal point of a number of routes used by inbound traffic from the Windward side of the island to Honolulu. The intersection is bounded by the Hawaii Loa College in the northwest quadrant and the Pali Golf Course in the southwest quadrant. H-3 is located approximately two miles west of Castle Junction.

PROJECT NEED

A design study was prepared in 1970. That study determined that the Castle Junction intersection operated at level-of-service E and that it would continue to do so for the foreseeable future unless significant improvements were implemented. Since that time, improvement of the intersection to a full access controlled facility has been in the State's Transportation Plan.

Pali Highway is one of two existing crossings of the Koolau Range used by commuters between Windward Oahu and Honolulu. The analyses presented in this report indicate that Castle Junction will continue to be a congestion point, even with completion of H-3, until it is upgraded. When the project is completed, a major congestion point and a source of driver delays will have been eliminated.

2.

EXISTING CONDITIONS

This chapter discusses the existing conditions at and in the vicinity of Castle Junction. Included is a discussion of the traffic volumes and accident history of the intersection. Also presented is a discussion of the level-of-service concept and the traffic conditions currently at the intersection.

Because of the proximity of the Hawaii Loa College and golf course entrances, these intersections are included in the analyses presented in this chapter.

EXISTING GEOMETRICS AND SIGNAL OPERATIONS

The existing geometrics are illustrated in Figure 2. As shown, the intersection has four legs. The north leg is Kalanianaole Highway, which is a four-lane, divided State highway. The approach to the intersection has a

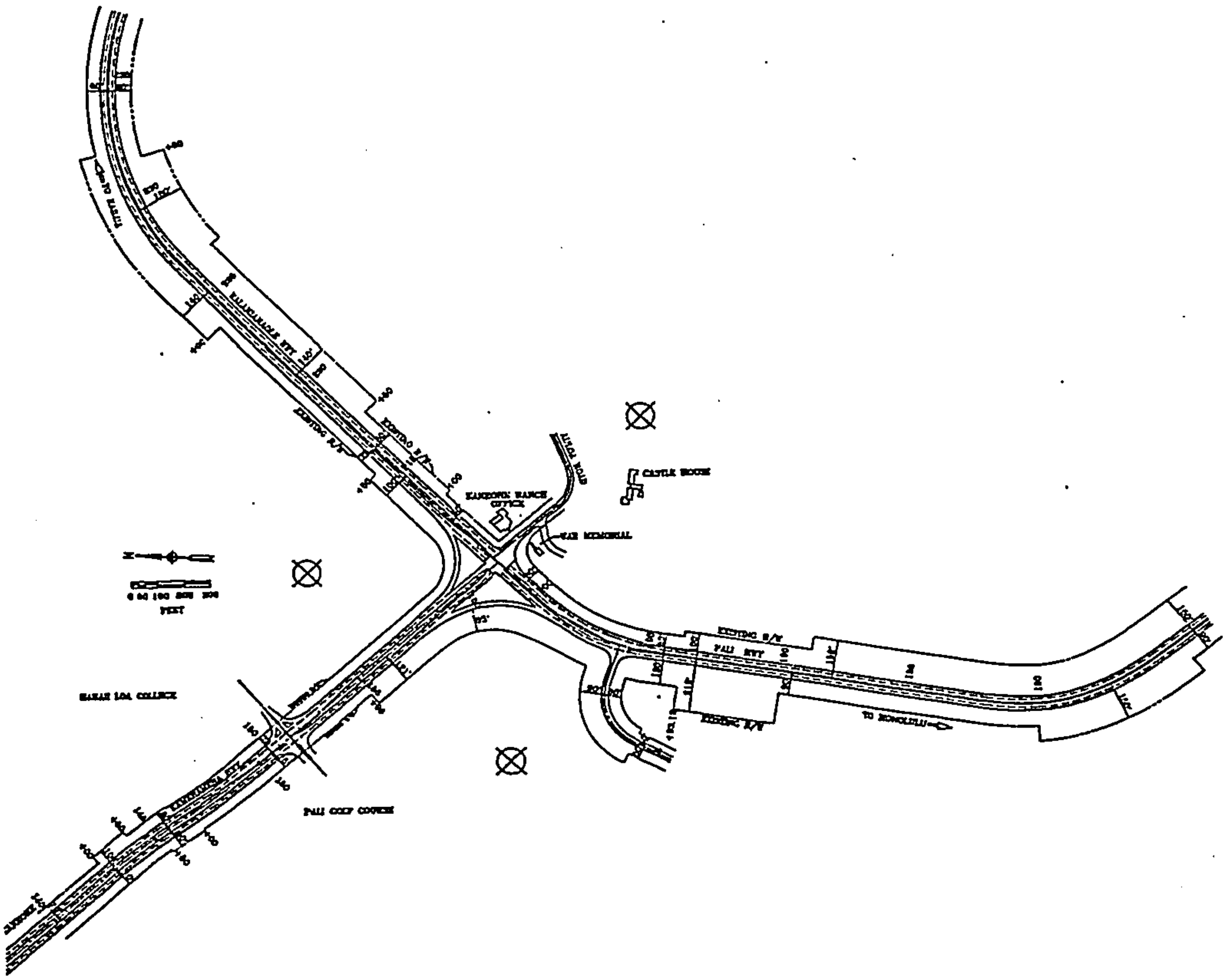


FIGURE 2
EXISTING INTERSECTION CONFIGURATION
Castle Junction Interchange Traffic Study

Barton-Aschman Associates, Inc.

separate southbound to eastbound left-turn lane and a southbound to westbound right-turn ramp.

The east leg of the intersection is Auloa Road. This roadway is a two-lane County facility serving the residential areas to the east. The approach to Castle Junction is striped for one lane, but it operates as a two-lane approach as the drivers use the left lane as a through and left-turn lane and the right lane as a right-turn only lane.

The south leg of the intersection is Pali Highway. Pali Highway is a four-lane divided State highway linking the northeast side of the island with Honolulu. The approach to Castle Junction is two through lanes and one left-turn lane. Right turns are allowed from the right through lane. Of particular concern is the downgrade of Pali Highway as it approaches Castle Junction. The gradient is 6.50 percent. This has a significant impact on the stopping sight distances and lengths of the acceleration and deceleration lanes.

The fourth and final leg is Kamehameha Highway, which is a four-lane State divided highway. The intersection approach is two left-turn lanes and a channelized right-turn lane. Through movements are allowed from the right left-turn lane.

The entrances to the Pali Golf Course and Hawaii Loa College are located approximately 1000 feet west of Castle Junction. Separate left-turn lanes are provided along Kamehameha Highway at these entrances.

Castle Junction is currently signalized. The signals provide separate left-turn phasing along the northbound and southbound approaches, and separate phases for the eastbound and westbound approaches.

The intersection of Kamehameha Highway and the college/golf course entrance is unsignalized.

EXISTING TRAFFIC VOLUMES

The existing traffic volumes were provided by HDOT. Average Daily Traffic (ADT) and morning and afternoon peak hour traffic volumes were provided. The ADT's are presented as Figure 3 and the morning and afternoon peak hour volumes are summarized as Figures 4 and 5, respectively.

LEVEL-OF-SERVICE CONCEPT

"Level-of-Service" is a term which denotes any of an infinite number of combinations of traffic operating conditions that may occur on a given lane or roadway when it is subjected to various traffic volumes. Level-of-service is a qualitative measure of the effect of a number of factors which include:

- Speed,
- Travel Time,
- Traffic Interruptions,
- Freedom to Maneuver,
- Safety,
- Driving Comfort,
- Convenience, and
- Operating Cost

There are six (6) levels-of-service, A through F, which relate to the driving conditions from best to worse, respectively. The characteristics of traffic operations for these levels-of-service are summarized in Table 1. In general, Level-of-Service A represents free-flow conditions with no congestion. Level-of-Service F, on the other hand, represents severe congestion with stop-and-go conditions.

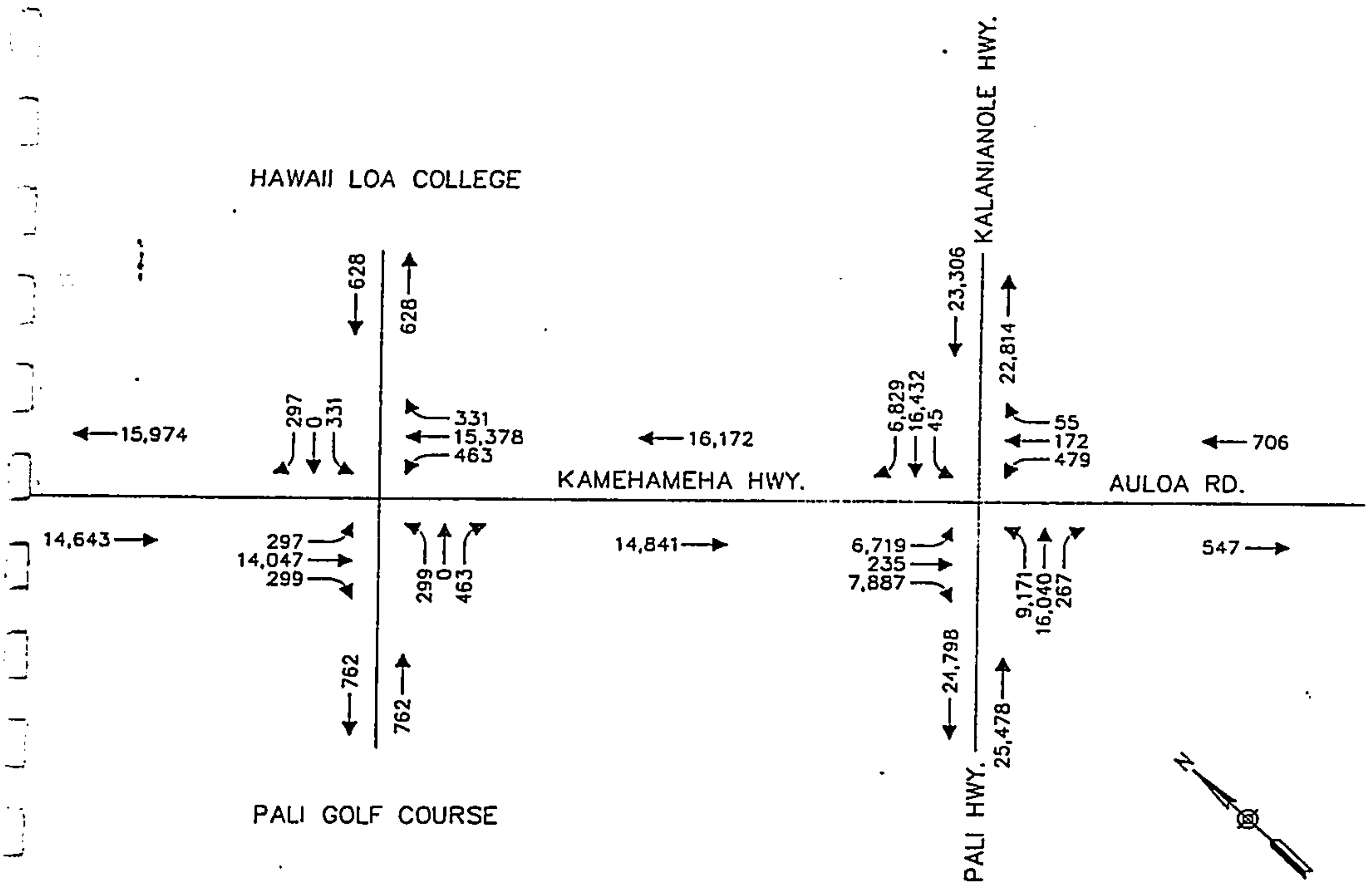


FIGURE 3
1988 AVERAGE DAILY TRAFFIC
Castle Junction Interchange Traffic Study

Barton-Aschman Associates, Inc.

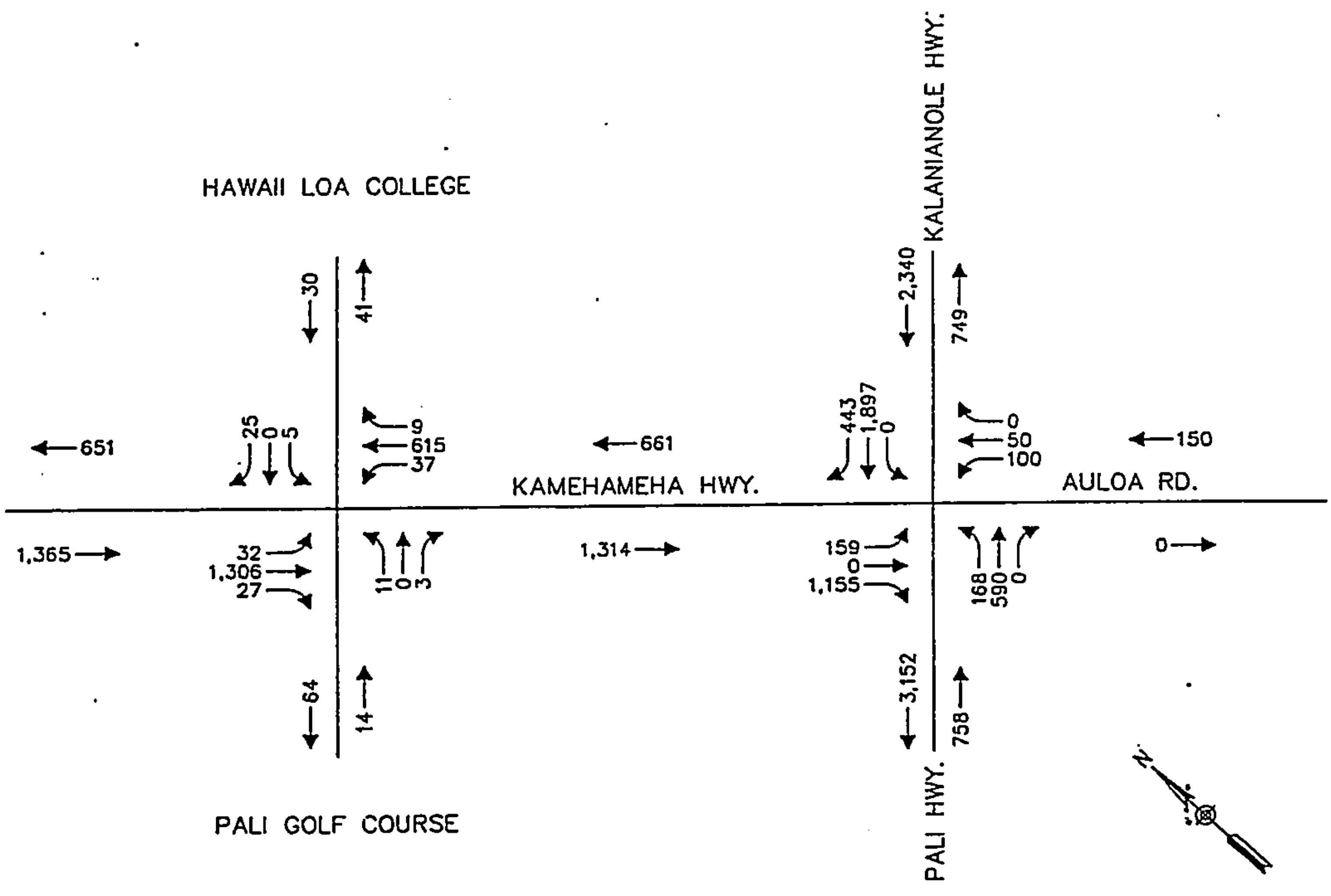


FIGURE 4
1988 AM PEAK HOUR TRAFFIC VOLUMES
Castle Junction Interchange Traffic Study

Barton-Aschman Associates, Inc.

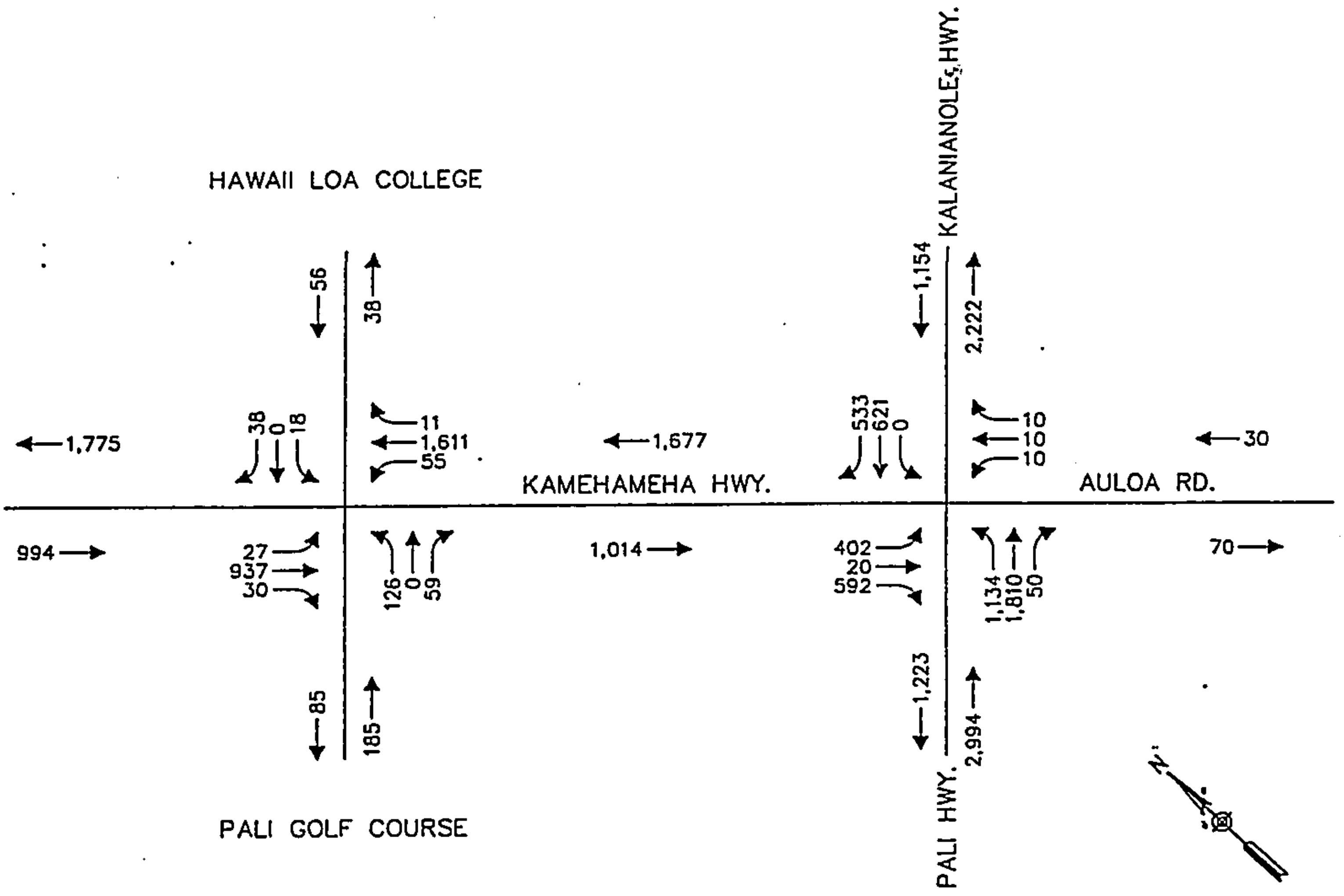


FIGURE 5
1988 PM PEAK HOUR TRAFFIC VOLUMES
Castle Junction Interchange Traffic Study

Barton-Aschman Associates, Inc.

Table 1
INTERSECTION LEVEL-OF-SERVICE DEFINITIONS (1)
CASTLE JUNCTION INTERCHANGE STUDY
April 1990

Level-of-Service	Interpretation	Volume-to-Capacity Ratio (2)	Stopped Delay Per Vehicle (Seconds)
A,B	Uncongested operations; all vehicles clear in a single cycle	0.000-0.700	<15.0
C	Light congestion; occasional backups on critical approaches	0.701-0.800	15.1 - 25.0
D	Congestion on critical approaches, but intersection functional. Vehicles required to wait through more than one cycle during short peaks. No long standing lines formed.	0.801-0.900	25.1 - 40.0
E	Severe congestion with some long-standing lines on critical approaches. Blockage of intersection may occur if traffic signal does not provide for protected turning movements.	0.901-1.000	40.1 - 60.0
F	Total breakdown with stop-and-go operation.	1.001+	>60.0

----

(1) Source: Highway Capacity Manual, 1985
(2) Volume/Level-of-Service E Capacity

Corresponding to each level-of-service shown in the table is a volume/capacity ratio. This is the ratio of either existing or projected traffic volumes to the capacity of the intersection. Capacity is defined as the maximum number of vehicles that can be handled by the roadway during a specified period of time. The capacity of a particular roadway is dependent upon its physical characteristics such as the number of lanes, the operational characteristics of the roadway (one-way, two-way, turn prohibitions, bus stops, etc.), and the type of traffic using the roadway (trucks, buses, etc.) and turning movements.

The Operations Methodology described in the 1985 Highway Capacity Manual was used to analyze the operational efficiency of the intersections subject to analysis. This method involves the calculation of a volume/capacity ratio (V/C) which is related to a level-of-service. The results of the level-of-service analysis is summarized in Table 2. The calculations are presented as Appendix A.

ACCIDENT HISTORY

Historical accident summaries for 1982 through 1987 were provided by HDOT. The number of reported accidents per year is summarized in Table 3. Examination of the records indicate that the number of reported accidents increased from 5 to 19 between 1986 and 1987. The largest number of accidents occurred in 1984, when 27 accidents were reported. Only one fatal accident was reported in the study period. This was in 1983. The remaining accidents were either person injury or property damage.

Only the reports for 1986 and 1987 provided information about the type of accident. Before this, the reports only indicated the injury/damage nature, the direction of travel and the time period (day or night only). The record for 1987 reported eight rear-end type accidents, eight side-swipe type accidents, one signal/yield violation and two as a result of "other" causes.

Table 2
1988 LEVEL-OF-SERVICE ANALYSIS
CASTLE JUNCTION INTERCHANGE STUDY
April 1990

Kamamehameha Highway at Pali Highway and Kalanianaole Highway

	AM Peak Hour			PM Peak Hour		
Year	V/C	Delay(2)	LoS	V/C	Delay(2)	LoS
1988	1.595	(1)	F	1.293	(1)	F

Kamamehameha Highway at Hawaii Loa College and Golf Course Entrances

	AM Peak Hour			PM Peak Hour		
Year	V/C	Delay(2)	LoS	V/C	Delay(2)	LoS
1988	0.574	6.9	A	0.789	11.0	C

Notes:

(1) HCS will not calculate a delay if the V/C ratio is greater than 1.2. Delay is greater than 60 seconds by definition of Level-of-Service F.

(2) Delay is defined as average vehicle delay in seconds.

Table 3
SUMMARY OF ACCIDENT HISTORY
CASTLE JUNCTION INTERCHANGE STUDY
April 1990

Year	Number of Accidents	Million Vehicles Entering	Accident Rate
1982	12	NA	NA
1983	19	NA	NA
1984	27	21,628,440	1.248
1985	13	21,999,960	0.591
1986	6	22,602,600	0.265
1987	19	23,299,200	0.815

The accident rate for 1987 was calculated to be 0.815 accidents per million entering vehicles (MEV). Comparative data to determine if this is a high accident rate for this type of roadway in Hawaii are not available.

3.

ANTICIPATED FUTURE TRAFFIC CONDITIONS

The purpose of this chapter is to present an overview of the anticipated future traffic conditions. This is important because these are the traffic volumes that must be ultimately accommodated by the new interchange at an acceptable level-of-service.

Future traffic conditions were examined for two time periods: 1995 and 2010. The traffic projections were provided by HDOT and were therefore reviewed for consistency with other traffic studies in the vicinity (i.e., traffic study for H-3). The assumptions and parameters used to make the projections are provided as Appendix B. This chapter presents only a summary of the volumes and the anticipated impacts of the level-of-service of Castle Junction.

1995 AND 2010 TRAFFIC VOLUMES

ADT and peak hour traffic volumes for 1995 are presented in Figures 6, 7 and 8, respectively. Projections for 2010 are presented in Figures 9, 10 and 11. The important item to note is the reductions in right turns from Kamehameha Highway to Pali Highway and left turns from Kamehameha Highway to Kalanianaole Highway between the present day (1988) and the future design years 1995 and 2010. These reductions represent the impact of H-3. However, the implication to the Castle Junction Interchange project is that measures to accommodate existing deficiencies will be over-designed for future traffic conditions.

The volumes are tabulated in Table 4.

ANTICIPATED FUTURE LEVELS-OF-SERVICE

The future levels-of-service were determined using the assumptions and procedures outlined in the previous chapter on existing conditions. The resulting levels-of-service, along with the existing for comparison, are presented in Table 5.

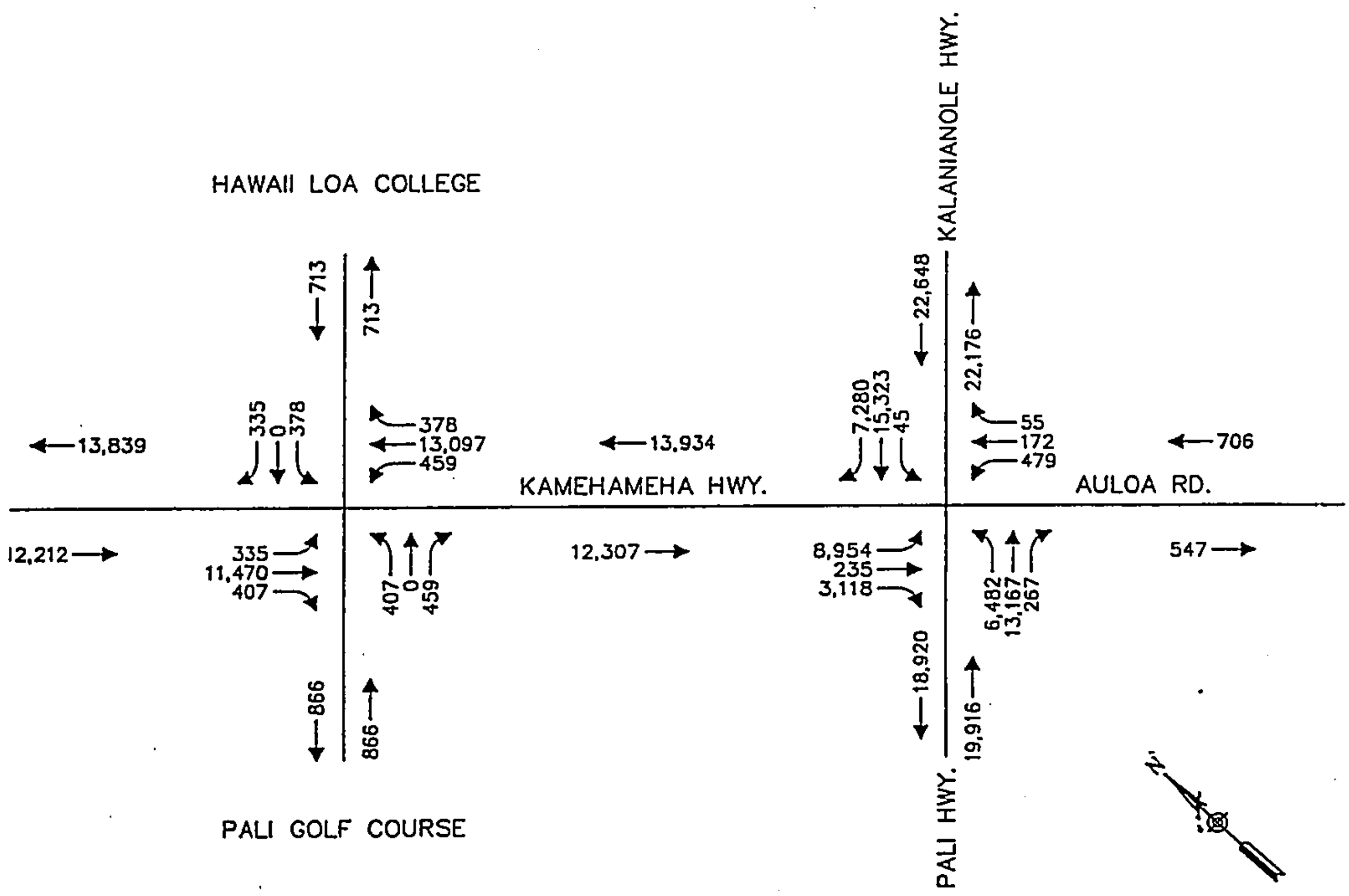


FIGURE 6
1995 AVERAGE DAILY TRAFFIC
Castle Junction Interchange Traffic Study

Barton-Aschman Associates, Inc.

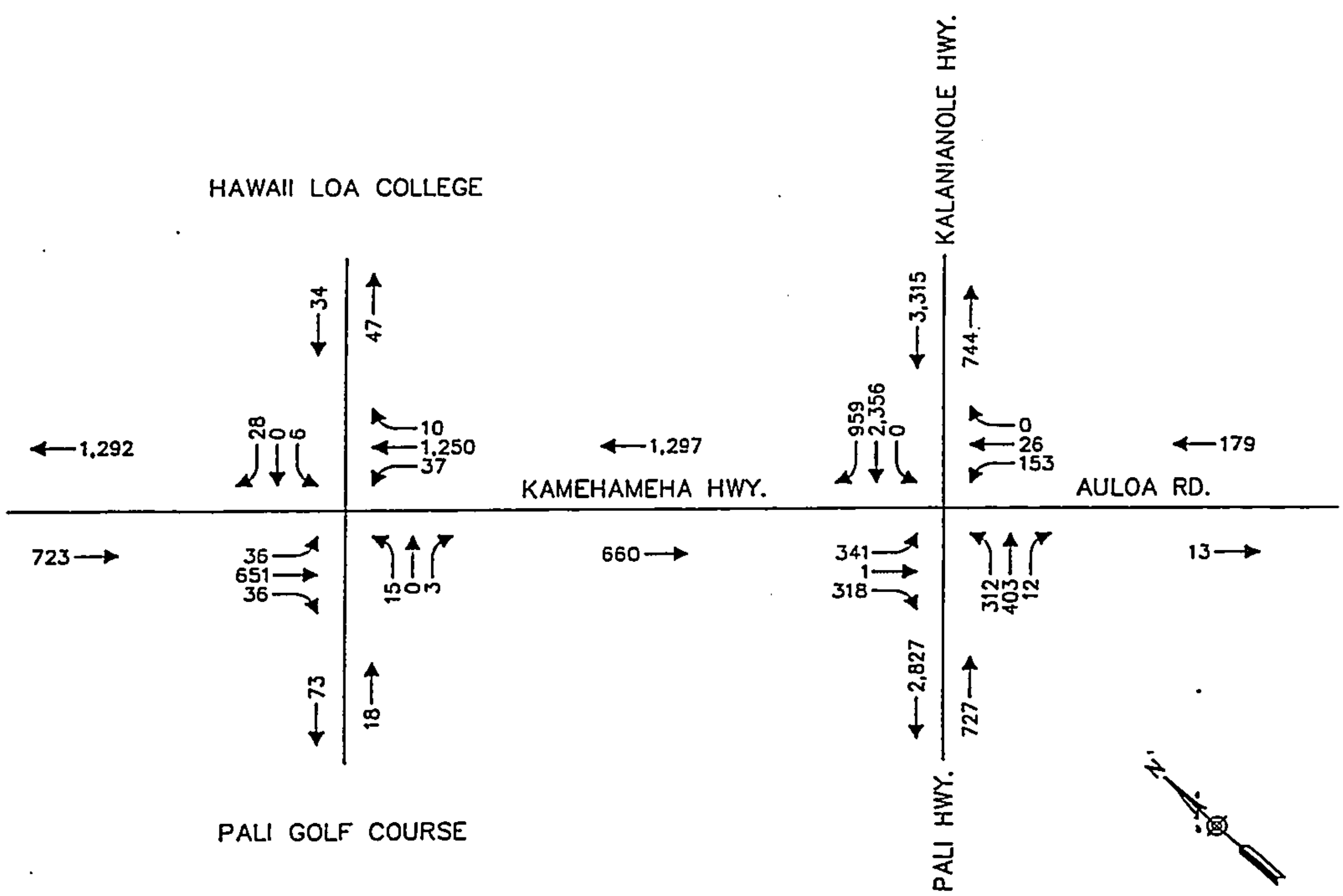


FIGURE 7
1995 AM PEAK HOUR TRAFFIC VOLUMES
Castle Junction Interchange Traffic Study

Barton-Aschman Associates, Inc.

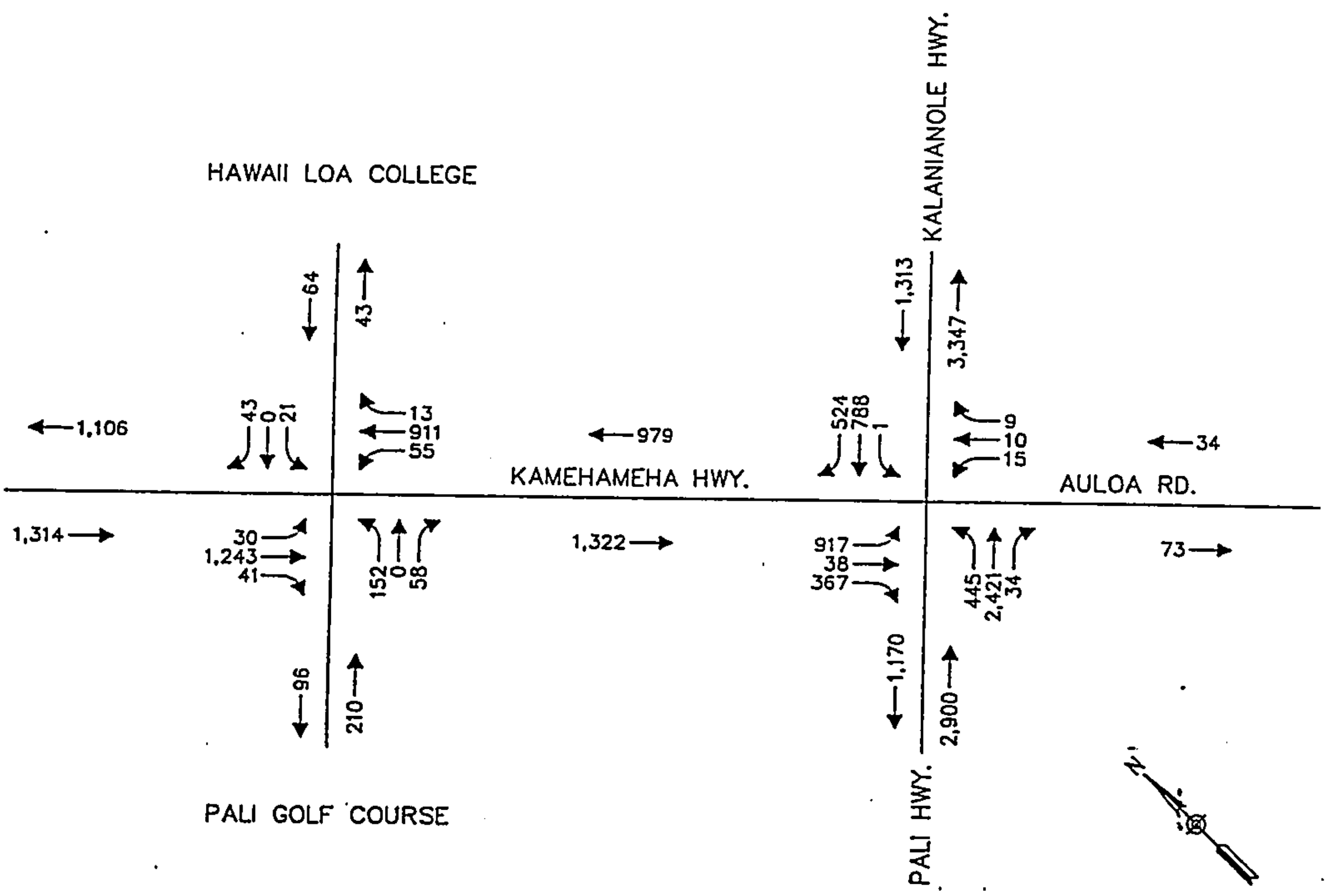


FIGURE 8
1995 PM PEAK HOUR TRAFFIC VOLUMES
Castle Junction Interchange Traffic Study

Barton-Aschman Associates, Inc.

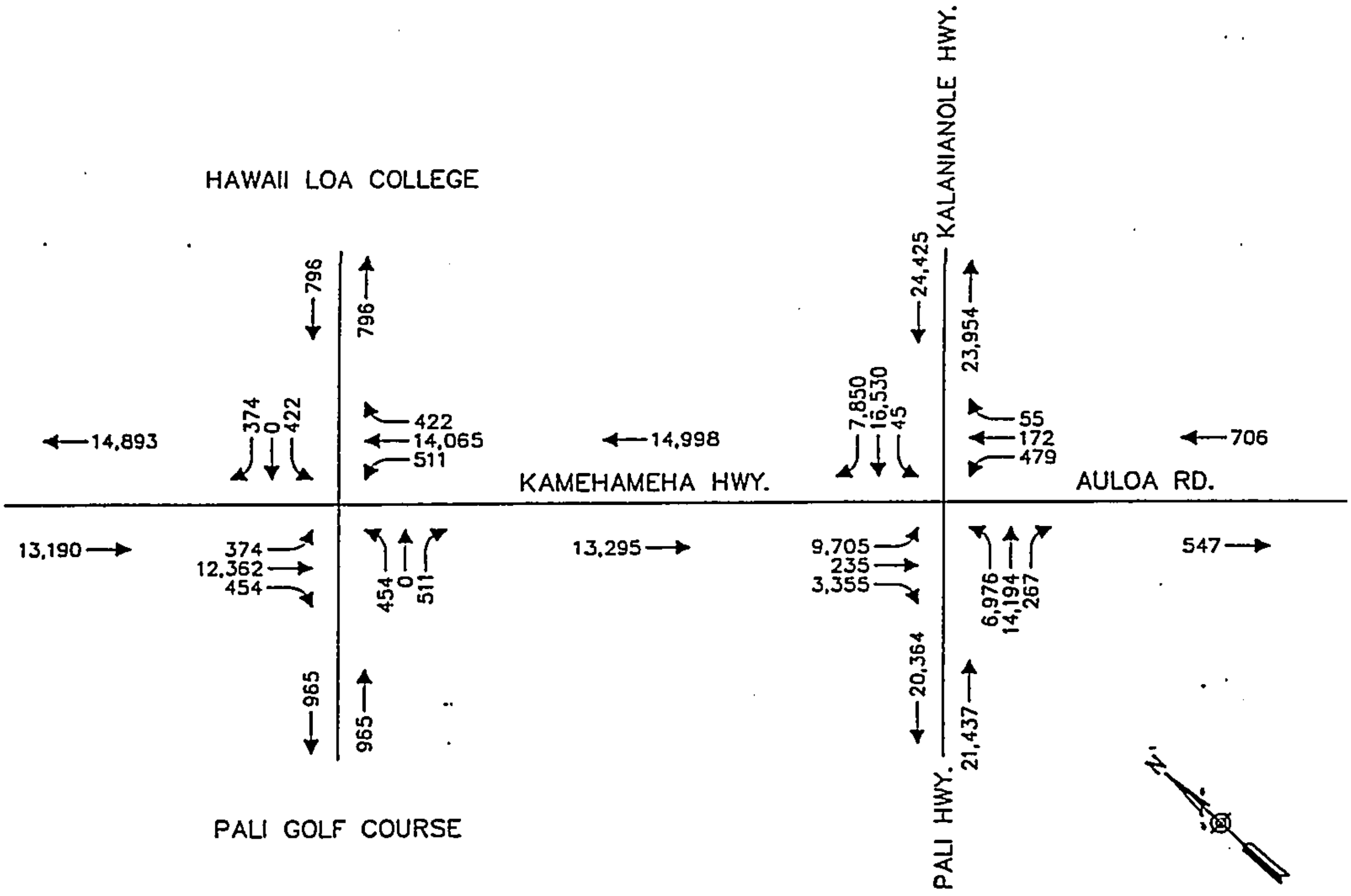


FIGURE 9
2010 AVERAGE DAILY TRAFFIC
Castle Junction Interchange Traffic Study

Barton-Aschman Associates, Inc.

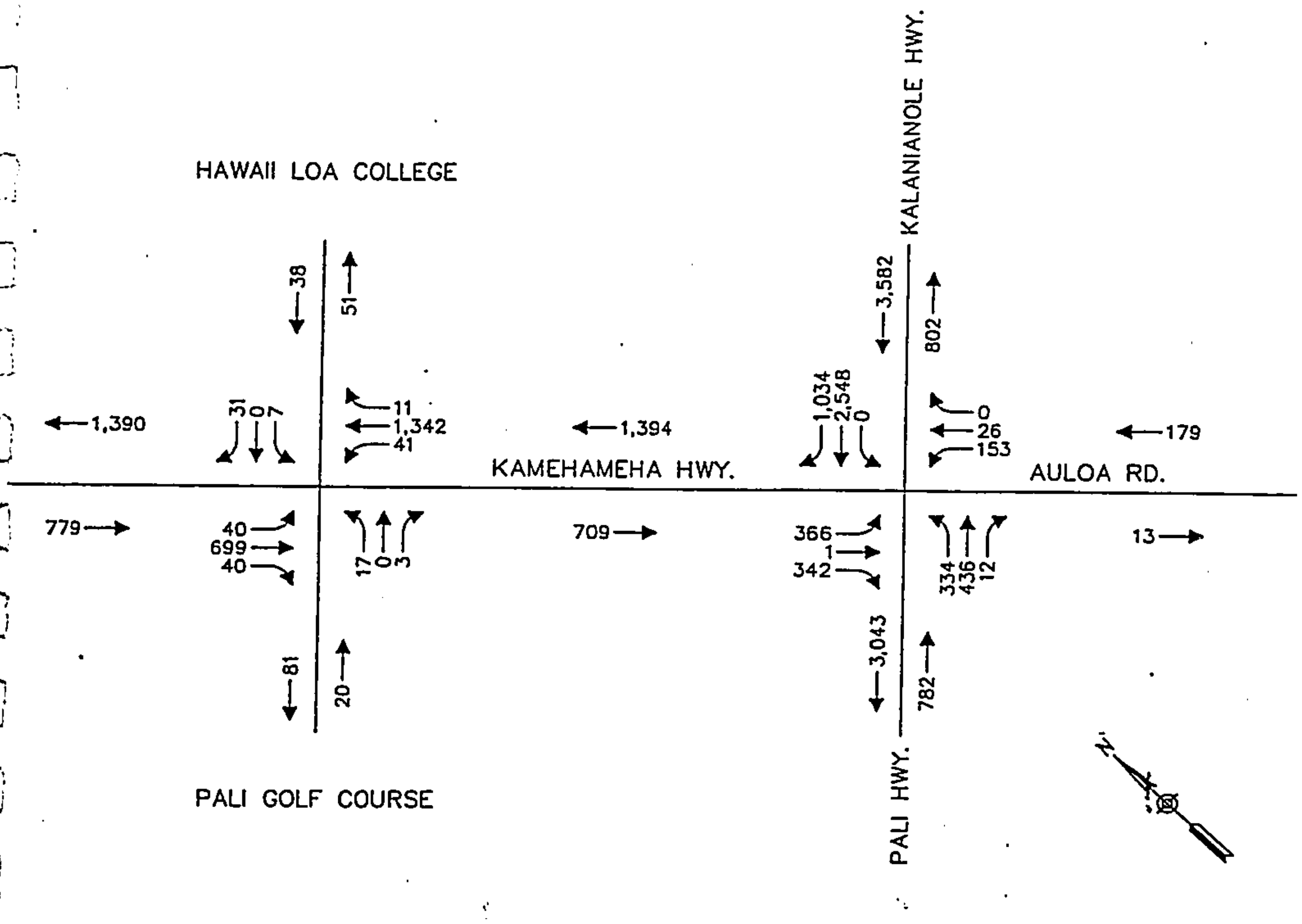


FIGURE 10
2010 AM PEAK HOUR TRAFFIC VOLUMES
Castle Junction Interchange Traffic Study

Barton-Aschman Associates, Inc.

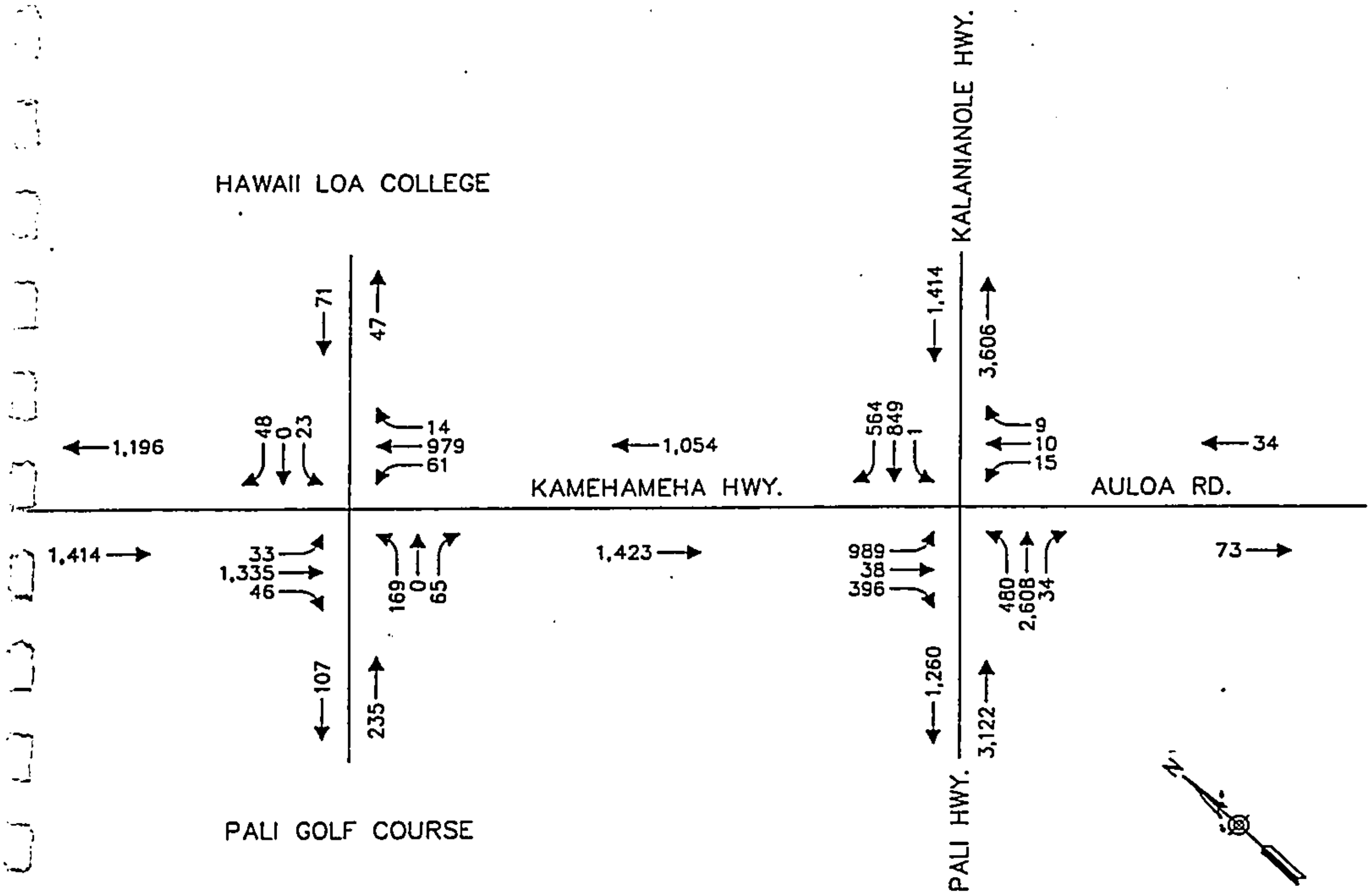


FIGURE 11
2010 PM PEAK HOUR TRAFFIC VOLUMES
Castle Junction Interchange Traffic Study

Barton-Aschman Associates, Inc.

Table 4
1995 AND 2010 LEVEL-OF-SERVICE ANALYSIS
CASTLE JUNCTION INTERCHANGE STUDY
April 1990

Kamamehameha Highway at Pali Highway and Kalanianaole Highway

	AM Peak Hour			PM Peak Hour		
Year	V/C	Delay[(2)]	LoS	V/C	Delay[(2)]	LoS
1988	1.595	(1)	F	1.293	(1)	F
1995	1.439	(1)	F	1.497	(1)	F
2010	1.524	(1)	F	1.616	(1)	F

Kamamehameha Highway at Hawaii Loa College and Golf Course Entrance

	AM Peak Hour			PM Peak Hour		
Year	V/C	Delay[(2)]	LoS	V/C	Delay[(2)]	LoS
1988	0.574	6.9	A	0.789	11.0	C
1995	0.554	6.8	A	0.663	10.9	B
2010	0.597	7.2	A	0.718	13.1	C

Notes:
(1) HCS will not calculate a delay if V/C ratio is greater than 1.2.

(2) Delay is defined as average vehicle delay in seconds. HCS will calculate V/C ratios differently than CRC which was presented in Table 2.

Table 5
SUMMARY OF EXISTING AND PROJECTED 1995 AND 2010 TRAFFIC VOLUMES
CASTLE JUNCTION INTERCHANGE STUDY
April 1990

Kamehameha Highway at Pali Highway and Kalanianaole Highway

Approach & Mvt	1988 Daily	1988 AM	1988 PM	1995 Daily	1995 AM	1995 PM	2010 Daily	2010 AM	2010 PM
1 N-Rt	6,829	443	533	7,280	959	525	7,850	1,034	564
2 Th	16,432	1,897	621	15,323	2,356	788	16,530	2,548	849
3 Lt	45	0	0	1	0	55	45	0	1
4 E-Rt	55	0	10	55	0	9	55	0	9
5 Th	172	50	10	172	26	10	172	26	10
6 Lt	479	100	10	479	153	15	479	153	15
7 S-Rt	267	0	50	267	12	34	267	12	34
8 Th	16,040	590	1,810	13,167	403	2,421	14,194	436	2,608
9 Lt	9,171	168	1,134	6,482	312	445	6,976	334	480
10 W-Rt	7,887	1,155	592	3,118	318	367	3,355	342	396
11 Th	235	0	20	235	1	38	235	1	38
12 Lt	6,719	159	402	8,934	341	917	9,705	366	989
Total	64,331	4,562	5,192	55,513	4,881	5,624	59,863	5,252	5,993

Kamehameha Highway at Hawaii Loa College and Golf Course Entrances

Approach & Mvt	1988 Daily	1988 AM	1988 PM	1995 Daily	1995 AM	1995 PM	2010 Daily	2010 AM	2010 PM
1 N-Rt	297	25	38	335	28	43	74	31	48
2 Th	0	0	0	0	0	0	0	0	0
3 Lt	331	5	18	378	6	21	422	7	23
4 E-Rt	331	9	11	378	10	13	422	11	14
5 Th	15,378	615	1,611	13,097	1,250	911	14,065	1,342	979
6 Lt	463	37	55	459	37	55	511	41	61
7 S-Rt	463	3	59	459	3	58	511	3	65
8 Th	0	0	0	0	0	0	0	0	0
9 Lt	299	11	126	407	15	152	454	17	169
10 W-Rt	299	27	30	407	36	41	454	40	46
11 Th	14,047	1,306	937	11,470	651	1,243	12,362	699	1,335
12 Lt	297	32	27	335	36	30	374	40	33
Total	32,205	2,070	2,912	27,725	2,072	2,567	29,949	2,231	2,773

4.

DEVELOPMENT OF ALTERNATIVES

The purpose of this chapter is to present an overview of the criteria used to develop the various interchange design alternatives. Included in this discussion are the design criteria used in the development of the alternatives and the typical sections developed using the criteria.

CRITERIA FOR ALTERNATIVES DEVELOPMENT

The primary source of the criteria used to develop the alternatives for Castle Junction was the Hawaii Statewide Uniform Design Manual for Streets and Highways. This document provides information relative to the specific design requirements, such as minimum radii, grades, lanes widths, etc., for streets and highways in Hawaii. The design criteria for the various classifications of roadways are presented as Appendix D and are summarized for Castle Junction in Table 6.

In addition, the 1985 Highway Capacity Manual was used to determine the lane requirements needed to accommodate the anticipated traffic volumes.

Table 6
DESIGN CRITERIA (1)
CASTLE JUNCTION INTERCHANGE STUDY
April 1990

Design Element	Highway	Major Ramps	Minor Ramps
Level-of-Service	C	C	C
Design Speed (mph)	50	25	15
Grades (%)			
Minimum	0.5	0.5	0.5
Maximum	7.0	8.0	10.0
Minimum Radius (Ft)	1000	150	50

Notes:
(1) Source: HDOT Design Manual

REQUIRED LANE CONFIGURATIONS

The lane requirements of the roadways and the ramps were determined using the methodology outlined in the 1985 Highway Capacity Manual (HCM). The objective of this analysis is to determine the number of lanes required along Pali, Kamehameha and Kalanianaole Highways. The design volumes for 2010 conditions were used.

The conclusions of this analysis are summarized as follows:

1. Three lanes are required for the Honolulu-bound direction along Pali and Kalanianaole Highways;

2. Three lanes are required for the Kailua-bound direction along Pali and Kalanianaole Highways north of and south of the interchange ramps, but two lanes are necessary to accommodate through traffic;

3. The current four lane, divided configuration along Kamehameha Highway will accommodate future traffic projections;

4. The outbound ramps from Pali Highway to Kamehameha Highway and from Kamehameha Highway to Kalanianaole Highway should be two lanes in width;

5. The inbound ramp from Kamehameha Highway to Pali Highway should be one lane to accommodate 1995 and 2010 traffic projections; however, two lanes would be necessary to provide for existing (without H-3) traffic volumes; and

6. Only one lane is required for the traffic from southbound Kalanianaole Highway to northbound Kamehameha Highway.

TYPICAL SECTIONS

Using the design criteria contained in the HDOT Design Manual and the lane configurations discussed above, the typical sections shown in Figures 12 and 13 were developed and were used to develop the alternatives presented in the following chapter.

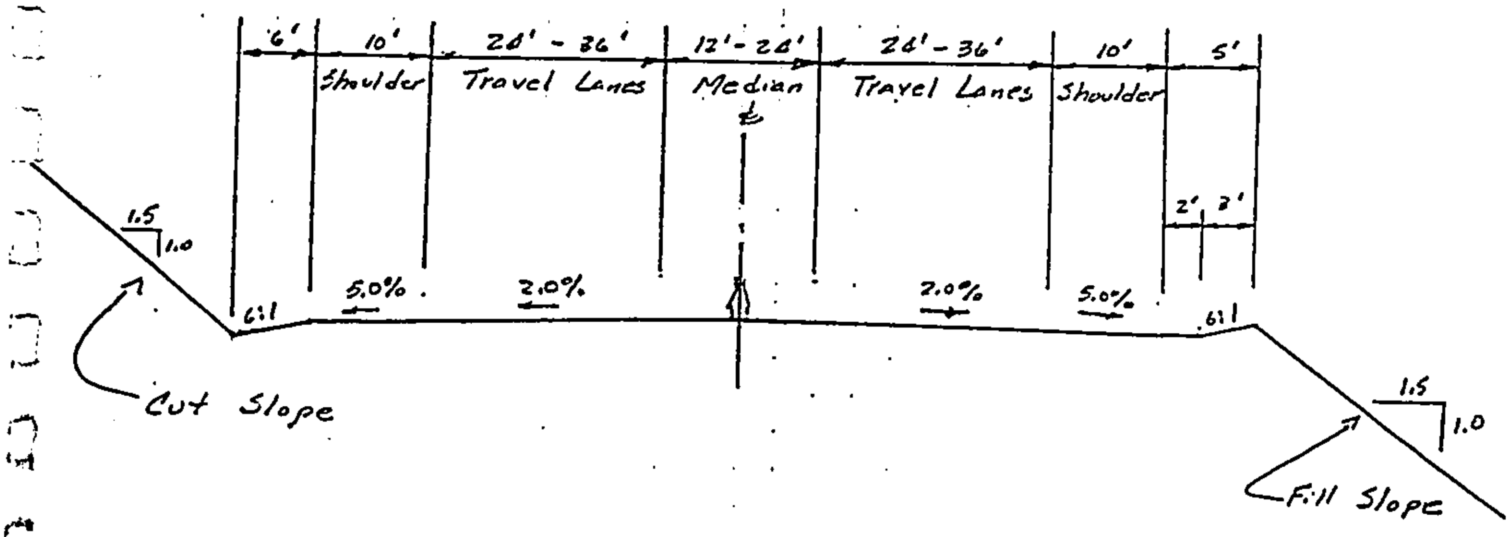


FIGURE 12
TYPICAL SECTION FOR PALI, KAMEHAMEHA,
AND KALANIANAOLE HIGHWAYS
Castle Junction Interchange Traffic Study

Barton-Aschman Associates, Inc.

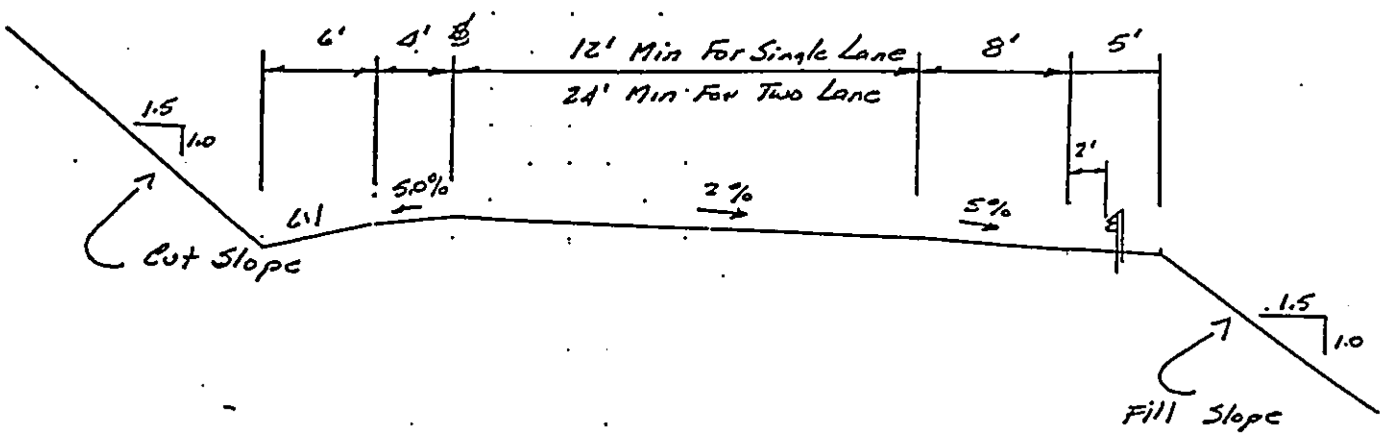


FIGURE 13
TYPICAL SECTION FOR RAMPS
Castle Junction Interchange Traffic Study

5.

DESCRIPTION OF ALTERNATIVES

The purpose of this chapter is to present a description of the alternatives developed. In addition, the No-Build and Transportation System Management (TSM) alternatives are also discussed. The evlauation of the alternatives is presented in the following chapter.

The alternatives discussed in this chapter were the result of a process involving the development of several conceptual alternatives and then reducing the number of alternatives for further study based on input obtained during a public meeting and discussions with HDOT and FHWA. The three alternatives selected for further study have been modified to reflect public input and further study during development and refinement.

The alternatives are as follows:

- Alternative A - Trumpet Interchange
- Alternative B - Directional Interchange
- Alternative C - Fully Directional Interchange
- Alternative D - Transportation System Management (TSM)
- Alternative E - No Build

ALTERNATIVE A - TRUMPET INTERCHANGE

Alternative A was developed by HDOT during the interchange studies conducted in 1970 and modified in this study to (1) reflect the lane requirements based on the latest traffic projections from HDOT, and (2) relocate the trumpet ramps such that the Kaneohe Ranch Office would not have to be destroyed. In the 1970 study this interchange was referred to as Alternative C.

The interchange is a trumpet configuration and is shown as Figure 14. The trumpet is located in the northeast quadrant. Outbound traffic from Honolulu would have to make a 270 degree turn to travel northbound along Kamehameha Highway. Traffic from Kamehameha Highway to Kalanianaole Highway would travel around the outside of the trumpet to travel to Kailua. The remaining right-turn movements to and from Kamehameha Highway are provided by direct ramps.

Service to Auloa Road east of Pali Highway would be provided and service would be provided from Auloa Road to Kaneohe via Kamehameha Highway. However, service from Kamehameha Highway would not be provided nor would service to and from Kalanianaole Highway.

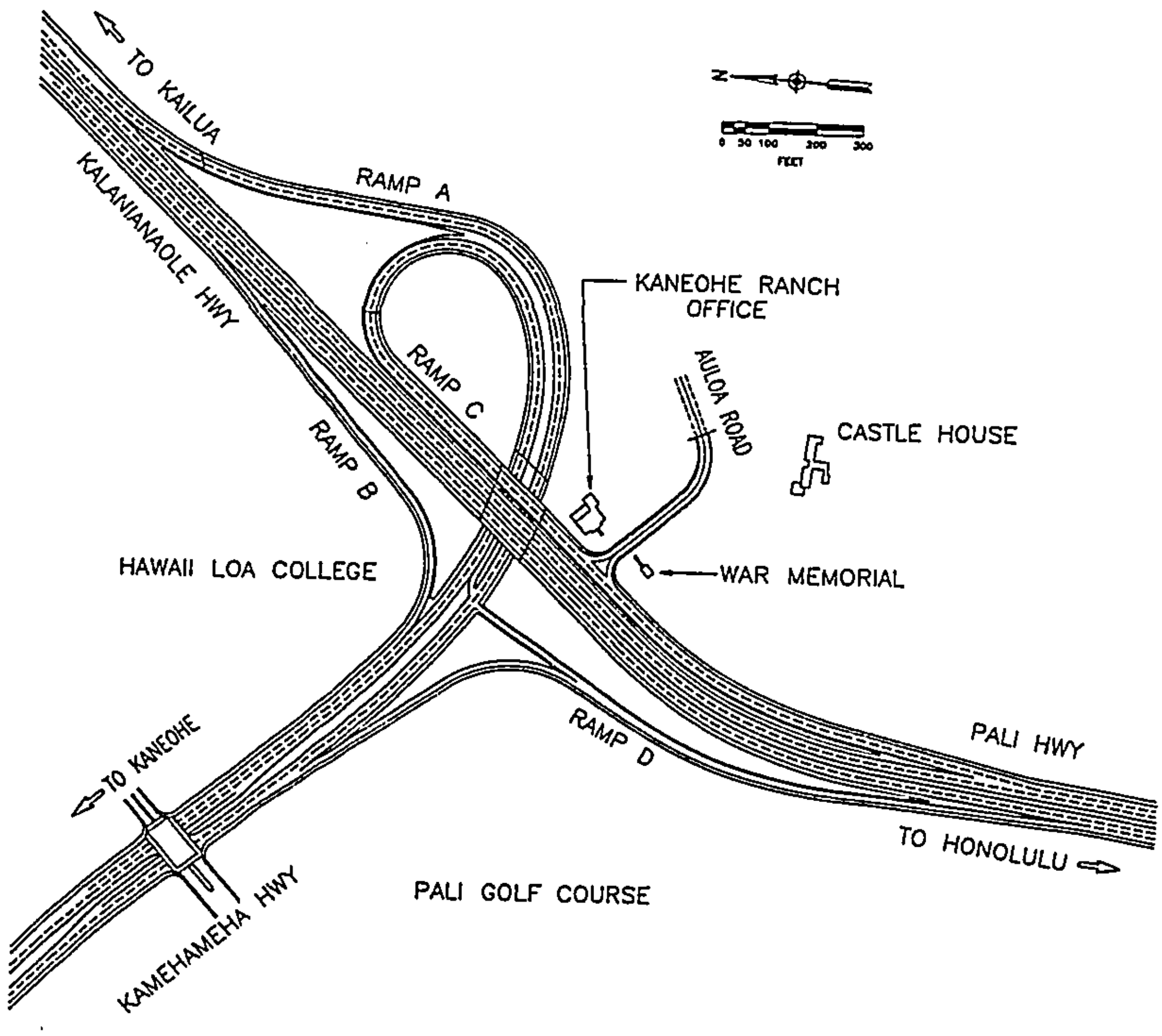


FIGURE 14
ALTERNATIVE A
Castle Junction Interchange Traffic Study

Barton-Aschman Associates, Inc.

Service to and from the Pali Golf Course and Hawaii Loa College would be provided via a signalized intersection at approximately the same location as the existing intersection.

The major disadvantage of this alternative is the limited access provided from the area east of the Pali Highway and the amount of right-of-way required from Hawaii Loa College. Also, if access is to be provided to the Wong property, right-of-way would have to be acquired from the Pali Golf Course which would require a 4(f) statement. If it is determined that the Wong property should be acquired, right-of-way would only be acquired from the College.

ALTERNATIVE B - DIRECTIONAL INTERCHANGE

This alternative was developed during the 1970 environmental study. As with Alternative A, the plan was modified to reflect current traffic projections and input from both the public and FHWA.

As shown in Figure 15, all traffic movements to and from the major highways would be provided for by direct ramps. Traffic movements between Auloa Road and Pali Highway would be provided for. However, movements between Auloa Road and Kamehameha and Kalanianaole Highways would not be provided for.

Access to and from Pali Golf Course and Hawaii Loa College would be provided via a signalized intersection approximately 700 feet north of the existing intersection along Kamehameha Highway. Traffic to and from the Pali Golf Course would use an underpass at the location of the existing intersection.

ALTERNATIVE C - FULLY DIRECTIONAL INTERCHANGE

Alternative C is a fully directional interchange (Figure 16). The Pali Highway to Kamehameha Highway movement would be via a two-lane flyover. The

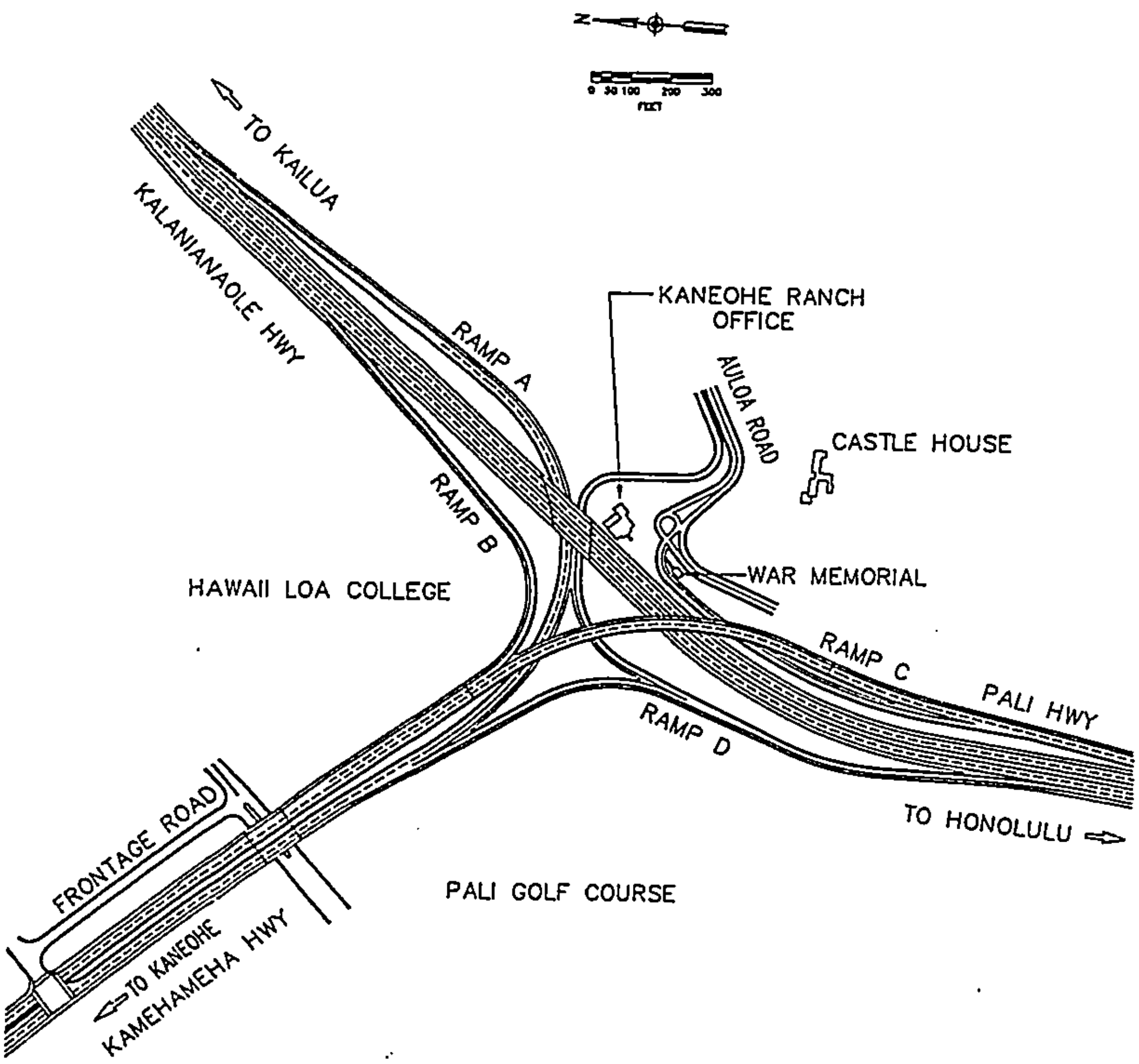


FIGURE 15
ALTERNATIVE B
Castle Junction Interchange Traffic Study

Barton-Aschman Associates, Inc.

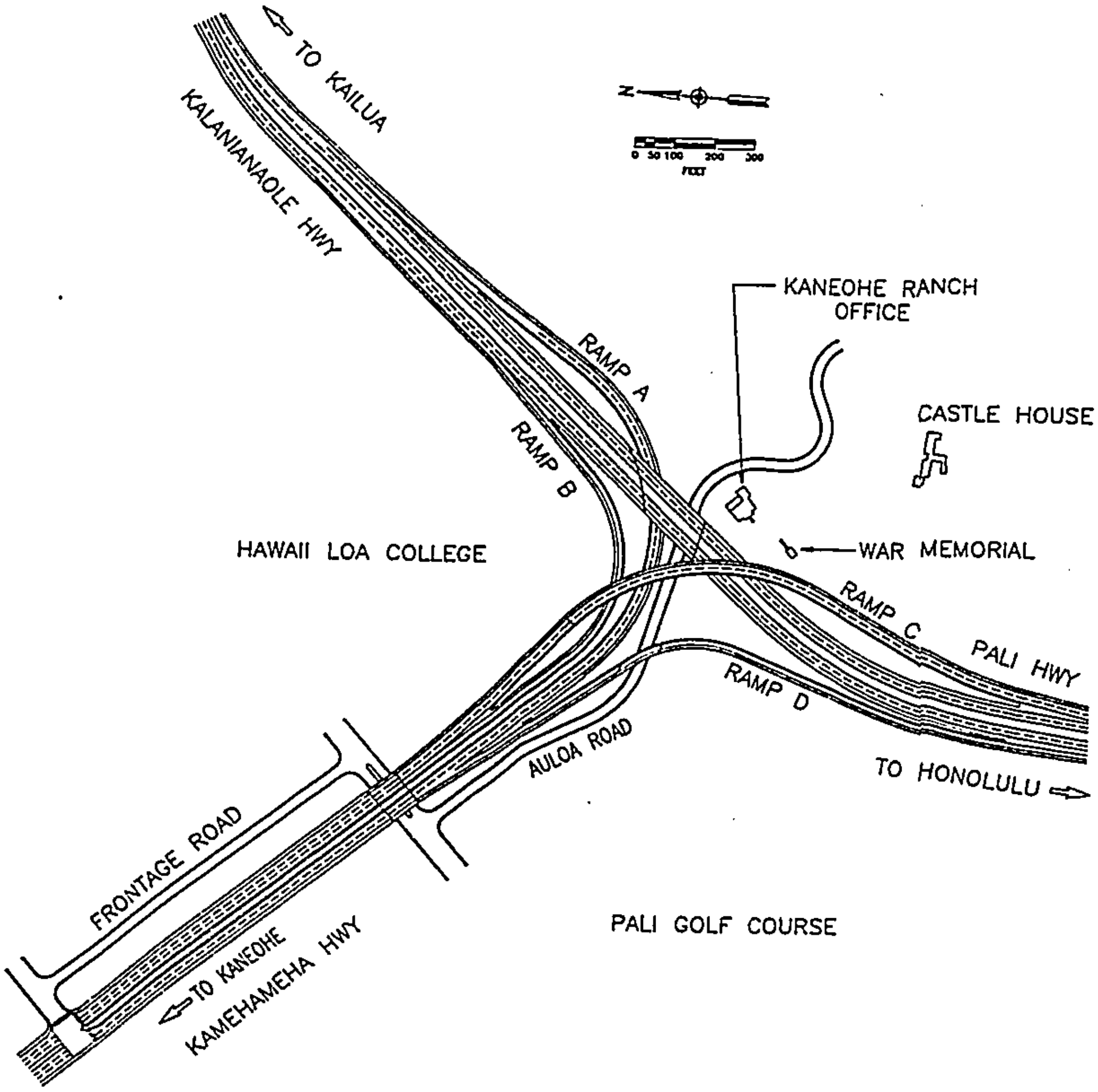


FIGURE 16
ALTERNATIVE C
Castle Junction Interchange Traffic Study

Barton-Aschman Associates, Inc.

remaining movements would be provided for by directional ramps. Access to Auloa Road would be via an underpass from north of the Kaneohe Ranch Office to a frontage road parallel to Kamehameha Highway and adjacent to the golf course.

Access to the golf course and the Hawaii Loa College would be via a new intersection approximately 700 feet north of the existing intersection. This would provide direct access to the colege at the location of a new entrance indicated on the college's master plan. A frontage road would link the new entrance with the roadway at the existing entrance. Traffic for the golf course would use an underpass at the location of the existing intersection.

ALTERNATIVE D - TRANSPORTATION SYSTEM MANAGEMENT

Transportation system management (TSM) refers to measures to reduce, or spread out, the peak hour. Typical measures include:

- o Ride-sharing (carpools),
- o Van pools,
- o Public transportation,
- o Flex-time working hours.

Since the measures are not design related, targets are set for the reduction of the peak hours' volume-to-capacity ratios to an acceptable level-of-service. The minimum acceptable level-of-service is C (Table 2-4 of the Design Manual), which indicates that the volume-to-capacity ratio should be between 0.701 and 0.800. Therefore, the maximum acceptable volume-to-capacity ratio is 0.800.

For purposes of this study, the 1995 design year has been examined in detail. The TSM alternative has been examined assuming that specific geometric improvements have been implemented. These improvements include the following:

1. The inbound left-turn movement from Kalanianaole Highway to Auloa Road is prohibited;

2. Traffic movements to and from Auloa Road have been restricted to right turns in and out only:

3. An additional outbound left-turn lane from Pali Highway to Kamehameha Highway has been installed; and

4. The traffic signal timing and phasing have been modified to reduce the signal cycle length to 240 seconds (4 minutes).

Table 7 is a summary of the peak hour levels-of-service that can be expected as a result of various reductions in the number of inbound and outbound trips during the morning and afternoon peak hours, respectively. As shown, a 40% reduction in the morning inbound peak hour traffic would have to be attained in order for the intersection to operate at level-of-service C (volume-to-capacity ratio = 0.78). This represents a reduction of approximately 1,000 vehicles. Using a person per auto ratio of 1.2, this translates to 1,200 persons that must be diverted to either a carpool or public transportation, or converted to flex-time hours.

For the afternoon peak hour, a 60% reduction in peak hour outbound traffic would result in level-of-service D (volume-to-capacity ratio = 0.82). Any further reduction did not seem practical.

Table 7
SUMMARY OF TSM ANALYSIS
CASTLE JUNCTION INTERCHANGE STUDY
April 1990

	Without Contra Flow (1)				With Contra Flow			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
Per Cent Peak Hour Reduction	V/C	LoS	V/C	LoS	V/C	LoS	V/C	LoS
0	1.13	F	1.22	F	0.84	D	1.22	F
10	1.05	F	1.13	F	0.78	C	1.13	F
20	0.96	E	1.05	F	0.72	C	1.05	F
30	0.87	D	0.96	E	0.66	B	0.96	E
40	0.78	C	0.88	D	0.60	B	0.88	D
50	0.69	B	0.82	D	0.55	b	0.79	C

ALTERNATIVE E - NO-BUILD

Alternative E is the No-Build alternative. This alternative assumes that no improvements are initiated at Castle Junction. The levels-of-service that would result from the No-Build alternaive are discussed in Chapter 3.

6.

EVALUATION OF ALTERNATIVES

This chapter presents the evaluation of the alternatives developed. The criteria used to evaluate the alternatives include the following:

A. Capacity (Level-of-Service)
B. Operations (Driver Comprehension)
C. Safety
D. Costs
E. Constructability
F. Construction Impacts
G. Aesthetics
H. Impacts on Public Transportation

Each criterion is discussed in the following paragraphs.

A. CAPACITY

Alternatives A, B, and C are designed to provide level-of-service C or better for 2010 traffic conditions. Alternative A, however, is limited by the capacity of the ramp from Pali Highway to Kamehameha Highway. Because the ramp limits the interchange capacity, the level-of-service for traffic greater than the 2010 design year traffic would be less than the desirable level-of-service C. Alternatives B and C both provide excess capacity that would accommodate traffic past the design year.

TSM requires a high percentage diversion of peak hour traffic to accommodate traffic at level-of-service D. The level-of-service cannot be better than D because at this point, traffic movements other than the inbound and outbound movements determine the level-of-service.

The No-Build alternative would result in level-of-service F for both 1995 and 2010 traffic conditions. Therefore, this alternative does not satisfy the project design criteria.

B. OPERATING (DRIVER COMPREHENSION)

Alternatives A, B, and C satisfy current design standards and would be signed in accordance with the latest edition of the Manual of Uniform Traffic Control Devices. Therefore, driver comprehension would be equivalent for all three of these alternatives.

C. SAFETY

All of the alternatives have been developed using established design standards. Therefore, there should be no difference in safety among the alternatives. However, it is generally accepted that the higher the level-of-service, the more safe is the intersection. As congestion and a lower level- of- service can be expected for the No-Build alternative, more minor accidents can be expected.

D. COSTS

Two types of cost were considered in the evaluation of the alternatives. One is the driver, or user, costs and the other is construction costs. User costs are a result of delays at the intersection. It is intuitive that the alternative with the least average driver delay would result in the least cost to the driver. Therefore, Alternate C would result in the least user costs since it has a higher design capacity which results in the least driver delay.

Alternative D (No-Build) would result in the longest average vehicle delays and therefore result in the highest user costs.

The construction costs of the alternatives are being developed independently.

E. CONSTRUCTABILITY

Constructability has been carefully considered and incorporated in the development of the alternatives. Alternatives A, B, and C would require phased construction in order to maintain traffic during construction. The inbound lanes west of the existing inbound lanes would be constructed first. Then the outbound lanes would be constructed. The flyover on Alternatives B and C could be constructed along with the first phase of construction. Sketches indicating the cnstruction phasing are presented in Appendix E.

Obviously, the TSM and No-Build Alternatives have any constructability implications.

F. CONSTRUCTION IMPACTS

Construction impacts include the disruption of traffic during construction. This was considered in development of the alternatives. Regardless of which alternative is selected, the new Honolulu-bound lanes along Kalanianaole and Pali Highway should be constructed first. Due to the centerline offset, four usable lanes would still remain north of the existing certerline. Traffic would, nevertheless, slow due to the adjacent construction.

Construction traffic (trucks, earth moving equipment, etc.) would also have to be provided as well as a construction site office. This equipment would also interfere with traffic movement, especially during the morning peak hour.

In summary, it can be anticiapted that the construction activity would have significant impacts on traffic operations. However, these impacts would be temporary and could be minimized by limiting construction to the early hour such that only the morning peak hour will be affected by construction activity at the site.

G. AESTHETICS

Aesthetics can only be evaluated subjectively. What one person finds acceptable may not be to another. Alternatives A, B, and C would all provide scenic views of the valley north of the site. As Alternative C has the higher flyover, it can be expected to provide the best views. However, the elevation of Kamehameha Highway west of Castle Junction to accommodate the ramps may have a negative impact on views from the College and Golf Course. The TSM and No-Build alternatives would result in traffic congestion which may be more unpleasing than the ramps.

H. IMPACTS ON PUBLIC TRANSPORTATION

Alternatives A, B, and C would require rerouting of the bus or elimination of bus stops along Pali Highway as stops would not be allowed on the controlled access interchange. The bus stops could be relocated to the area adjacent to the College entrance. However, the impacts on the bus riding public would be minimal.

TSM and No-Build would not impact the existing bus operations along Pali Highway or Kamehameha Highway.

APPENDIX A

LEVEL OF SERVICE CALCULATIONS FOR
EXISTING CONDITIONS

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..KAMEHAMEHA HWY/PALI/KALANIANIOLE HWY
AREA TYPE.....OTHER
ANALYST.......SR
DATE..........4/11/90
TIME..........1988 AM PEAK HOUR
COMMENT.....KP88AH

	VOLUMES				:	GEOMETRY							
	EB	WB	NB	SB	:	EB		WB		NB		SB	
LT	159	100	168	0	:	L	12.0	L	12.0	L	12.0	L	12.0
TH	0	50	590	1897	:	LT	12.0	TR	12.0	T	12.0	T	12.0
RT	1155	0	0	443	:	R	12.0		12.0	T	12.0	T	12.0
RR	173	0	0	89	:		12.0		12.0	R	12.0	R	12.0
					:		12.0		12.0		12.0		12.0
					:		12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.90	50	N	31.8	3
WB	0.00	2.00	N	0	0	0.90	50	N	31.8	3
NB	0.00	2.00	N	0	0	0.90	50	N	22.8	3
SB	0.00	2.00	N	0	0	0.90	50	N	22.8	3

SIGNAL SETTINGS CYCLE LENGTH = 100.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT	X	X		
	TH	X					TH		X	X	
	RT	X					RT		X	X	
	PD						PD				
WB	LT	X				SB	LT	X			
	TH	X					TH			X	
	RT	X					RT			X	
	PD						PD				
GREEN		10.0	0.0	0.0	0.0	GREEN		5.0	8.0	62.0	0.0
YELLOW		4.0	0.0	0.0	0.0	YELLOW		3.0	4.0	4.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.400	0.110	32.3	D	*	*
	LT	0.582	0.110	30.2	D		
	R	4.503	0.160	*	*		
WB	L	1.559	0.110	*	*	*	*
	TR	0.283	0.110	26.6	D		
NB	L	0.649	0.170	32.9	D	9.0	B
	T	0.258	0.750	2.5	A		
	R	0.000	0.750	3.3	A		
SB	L	0.000	0.050	30.0	D	19.4	C
	T	0.986	0.630	21.8	C		
	R	0.412	0.630	6.1	B		

INTERSECTION: Delay = * (sec/veh) V/C = 1.595 LOS = *

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..KAMEHAMEHA HWY/PALI/KALANIANIOLE HWY
AREA TYPE.....OTHER
ANALYST.......SR
DATE..........4/11/90
TIME..........1988 PM PEAK HOUR
COMMENT.....KP88PM

	VOLUMES EB	WB	NB	SB	:	GEOMETRY EB		WB		NB		SB	
LT	402	10	1134	0	:	L	12.0	L	12.0	L	12.0	L	12.0
TH	20	10	1810	621	:	LT	12.0	TR	12.0	T	12.0	T	12.0
RT	592	10	50	533	:	R	12.0		12.0	T	12.0	T	12.0
RR	592	0	0	267	:		12.0		12.0	R	12.0	R	12.0
					:		12.0		12.0		12.0		12.0
					:		12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.90	50	N	31.8	3
WB	0.00	2.00	N	0	0	0.90	50	N	31.8	3
NB	0.00	2.00	N	0	0	0.90	50	N	22.8	3
SB	0.00	2.00	N	0	0	0.90	50	N	22.8	3

SIGNAL SETTINGS — CYCLE LENGTH = 100.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT	X	X		
	TH	X					TH		X	X	
	RT	X					RT		X	X	
	PD						PD				
WB	LT	X				SB	LT	X			
	TH	X					TH			X	
	RT	X					RT			X	
	PD						PD				
GREEN		15.0	0.0	0.0	0.0	GREEN		5.0	44.0	21.0	0.0
YELLOW		4.0	0.0	0.0	0.0	YELLOW		3.0	4.0	4.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.262	0.160	28.1	D	*	*
	LT	1.430	0.160	*	*		
	R	0.000	0.210	21.2	C		
WB	L	0.156	0.160	27.6	D	24.4	C
	TR	0.084	0.160	23.1	C		
NB	L	1.404	0.530	*	*	*	*
	T	0.846	0.700	8.9	B		
	R	0.052	0.700	3.0	A		
SB	L	0.000	0.050	30.0	D	35.9	D
	T	0.924	0.220	34.8	D		
	R	0.886	0.220	38.4	D		

INTERSECTION: Delay = * (sec/veh) V/C = 1.293 LOS = *

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT
****
INTERSECTION..KAMEHAMEHA HWY/COLLEGE/GOLF ENTRANCE
AREA TYPE.....CBD
ANALYST.......SR
DATE..........4/11/90
TIME..........1988 AM PEAK HOUR
COMMENT.......HK88AM

VOLUMES					:	GEOMETRY							
	EB	WB	NB	SB	:	EB		WB		NB		SB	
LT	32	37	11	5	:	L	12.0	L	12.0	L	12.0	L	12.0
TH	1306	615	0	0	:	T	12.0	T	12.0	R	12.0	R	12.0
RT	27	9	3	25	:	T	12.0	T	12.0		12.0		12.0
RR	27	9	0	0	:	R	12.0	R	12.0		12.0		12.0
					:		12.0		12.0		12.0		12.0
					:		12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. BUT. Y/N	min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.90	50	N	19.8	3
WB	0.00	2.00	N	0	0	0.90	50	N	19.8	3
NB	0.00	2.00	N	0	0	0.90	50	N	31.8	3
SB	0.00	2.00	N	0	0	0.90	50	N	31.8	3

SIGNAL SETTINGS CYCLE LENGTH = 100.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT	X			
	TH		X				TH				
	RT		X				RT	X			
	PD						PD				
WB	LT	X				SB	LT	X			
	TH		X				TH				
	RT		X				RT	X			
	PD						PD				
GREEN		10.0	68.0	0.0	0.0	GREEN		10.0	0.0	0.0	0.0
YELLOW		4.0	4.0	0.0	0.0	YELLOW		4.0	0.0	0.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.212	0.110	30.9	D	7.0	B
	T	0.688	0.690	6.5	B		
	R	0.000	0.800	1.3	A		
WB	L	0.245	0.110	31.1	D	5.5	B
	T	0.324	0.690	4.0	A		
	R	0.000	0.800	1.3	A		
NB	L	0.073	0.110	30.3	D	28.1	D
	R	0.011	0.220	19.7	C		
SB	L	0.033	0.110	30.2	D	21.8	C
	R	0.093	0.220	20.1	C		

INTERSECTION: Delay = 6.9 (sec/veh) V/C = 0.574 LOS = B

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT
****
INTERSECTION..KAMEHAMEHA HWY/COLLEGE/GOLF ENTRANCE
AREA TYPE.....CBD
ANALYST.......SR
DATE..........4/11/90
TIME..........1988 PM PEAK HOUR
COMMENT.......HK88PM

	VOLUMES				:	GEOMETRY							
	EB	WB	NB	SB	:		EB		WB		NB		SB
LT	27	55	126	18	:	L	12.0	L	12.0	L	12.0	L	12.0
TH	937	1611	0	0	:	T	12.0	T	12.0	R	12.0	R	12.0
RT	30	11	59	38	:	T	12.0	T	12.0		12.0		12.0
RR	30	11	0	0	:	R	12.0	R	12.0		12.0		12.0
					:		12.0		12.0		12.0		12.0
					:		12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.90	50	N	14.5	3
WB	0.00	2.00	N	0	0	0.90	50	N	14.5	3
NB	0.00	2.00	N	0	0	0.90	50	N	26.5	3
SB	0.00	2.00	N	0	0	0.90	50	N	26.5	3

SIGNAL SETTINGS CYCLE LENGTH = 100.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT	X			
	TH		X				TH				
	RT		X				RT	X			
	PD						PD				
WB	LT	X				SB	LT	X			
	TH		X				TH				
	RT		X				RT	X			
	PD						PD				
GREEN		10.0	67.0	0.0	0.0	GREEN		11.0	0.0	0.0	0.0
YELLOW		4.0	4.0	0.0	0.0	YELLOW		4.0	0.0	0.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.179	0.110	30.8	D	5.8	B
	T	0.501	0.680	5.2	B		
	R	0.000	0.800	1.3	A		
WB	L	0.365	0.110	32.0	D	11.0	B
	T	0.862	0.680	10.3	B		
	R	0.000	0.800	1.3	A		
NB	L	0.766	0.120	44.1	E	36.4	D
	R	0.209	0.230	20.2	C		
SB	L	0.109	0.120	29.8	D	23.0	C
	R	0.135	0.230	19.8	C		

INTERSECTION: Delay = 11.0 (sec/veh) V/C = 0.789 LOS = B

APPENDIX B

FUTURE TRAFFIC PROJECTIONS FROM HDOT

TRAFFIC ASSIGNMENT PROJECT TA 88-5
CASTLE JUNCTION INTERCHANGE
PROJECT NO. RF-061-1(17)

Received 3/22/89 Bm

JUNE 1988

PURPOSE

Information from this traffic assignment project will be used for planning studies.

REQUIREMENTS

- 1988, 1995 and 2010 ADT, AM PEAK HOUR TRAFFIC and PM PEAK HOUR TRAFFIC
- T_{AM}, T_{PM} and T_{24}
- FACTORS FOR AIR QUALITY AND NOISE STUDIES

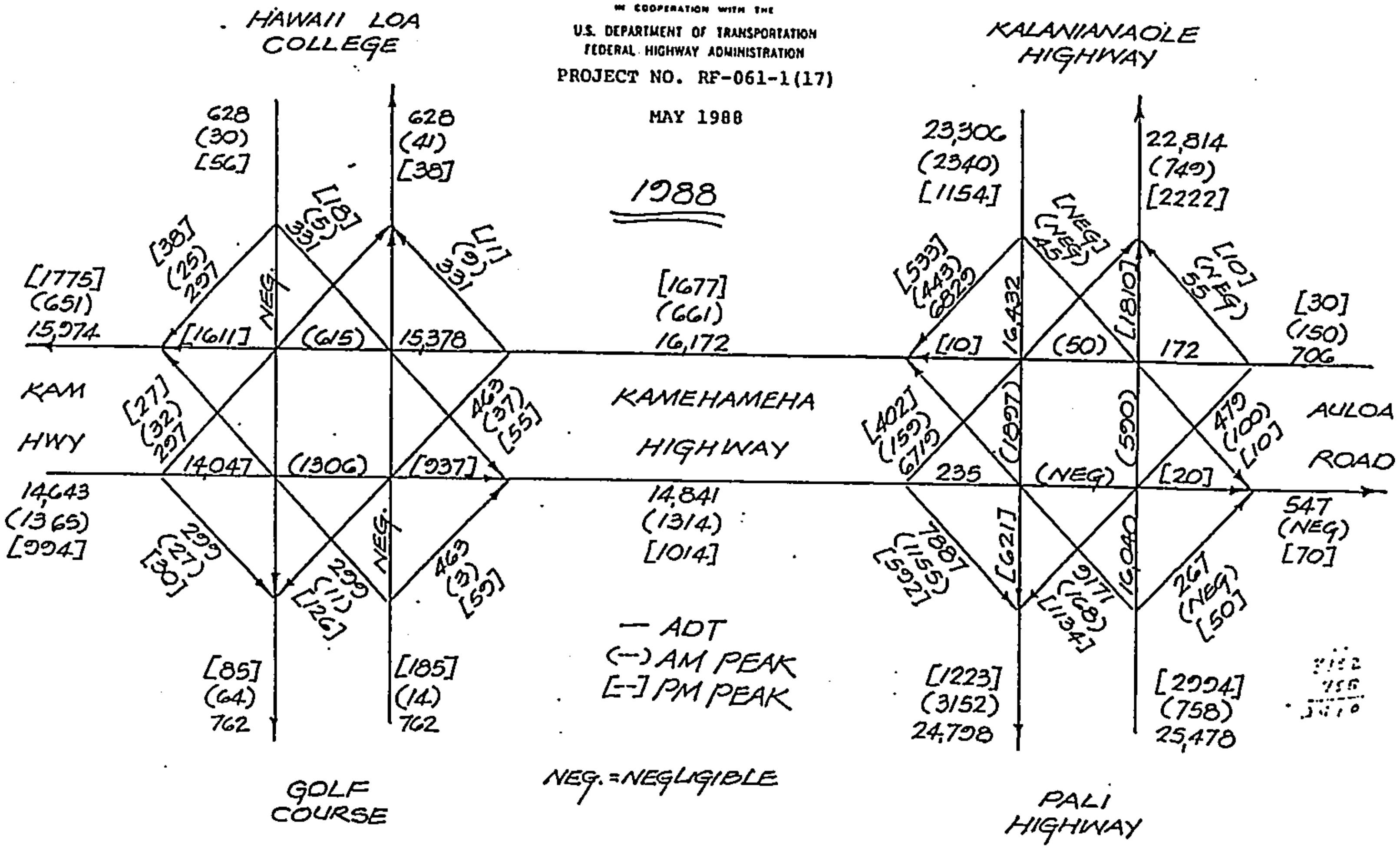
BASIC CONDITIONS AND ASSUMPTIONS

- Desire traffic is presented.
- Volumes presented were based on current ground counts and traffic developed in TA 84-17, Interstate Route H-3.
- For all years the traffic for Auloa Road was controlled by the volumes developed in TA 84-17.
- The 1995 and 2010 volumes reflect a completed Interstate Route H-3.
- Traffic for 1988 was determined from 1988 ground counts.
- 1995 and 2010 24-hour leg volumes for Kamehameha, Pali and Kalanianaole Highways were determined by backcasting and extrapolating 1998 and 2008 traffic developed in TA 84-17.
- 1995 and 2010 24-hour leg volumes for the roads leading to Hawaii Loa College and Pali Golf Course were determined by applying growth factors to the 1988 traffic. Growth factors were developed from Trans-Koolau corridor traffic (TA 84-17).
- Turning movements at Castle Junction were backcasted and extrapolated from 1998 and 2008 volumes from TA 84-17.
- 1995 turning movements at the Pali Golf Course Road intersection were estimated. Growth factors based on the 1995 and 2010 leg volumes were applied to the 1995 turns to determine the 2010 turns.
- AM and PM Peak hour volumes for Castle Junction were determined in the same manner as the ADT.
- K factors based on 1988 traffic were applied to the 1995 24-hour turns to determine the AM and PM peak hour traffic entering and leaving Pali Golf Course and Hawaii Loa College. A growth factor developed from Trans-Koolau corridor traffic (TA 84-17) was applied to the 1995 volumes to determine the 2010 AM and PM peak hour volumes. Through movements on Kamehameha Highway for 1995 and 2010 were deduced.
- AM and PM K and D factors were determined from the 2010 traffic.
- Truck factors for design, noise and air quality studies were based on vehicle-type classification counts and truck-weight studies.

TRAFFIC ASSIGNMENT PROJE[illegible] TA 88-5
CASTLE JUNCTION INTER[illegible]ANGE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
PREPARED BY THE
PLANNING BRANCH
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
PROJECT NO. RF-061-1(17)

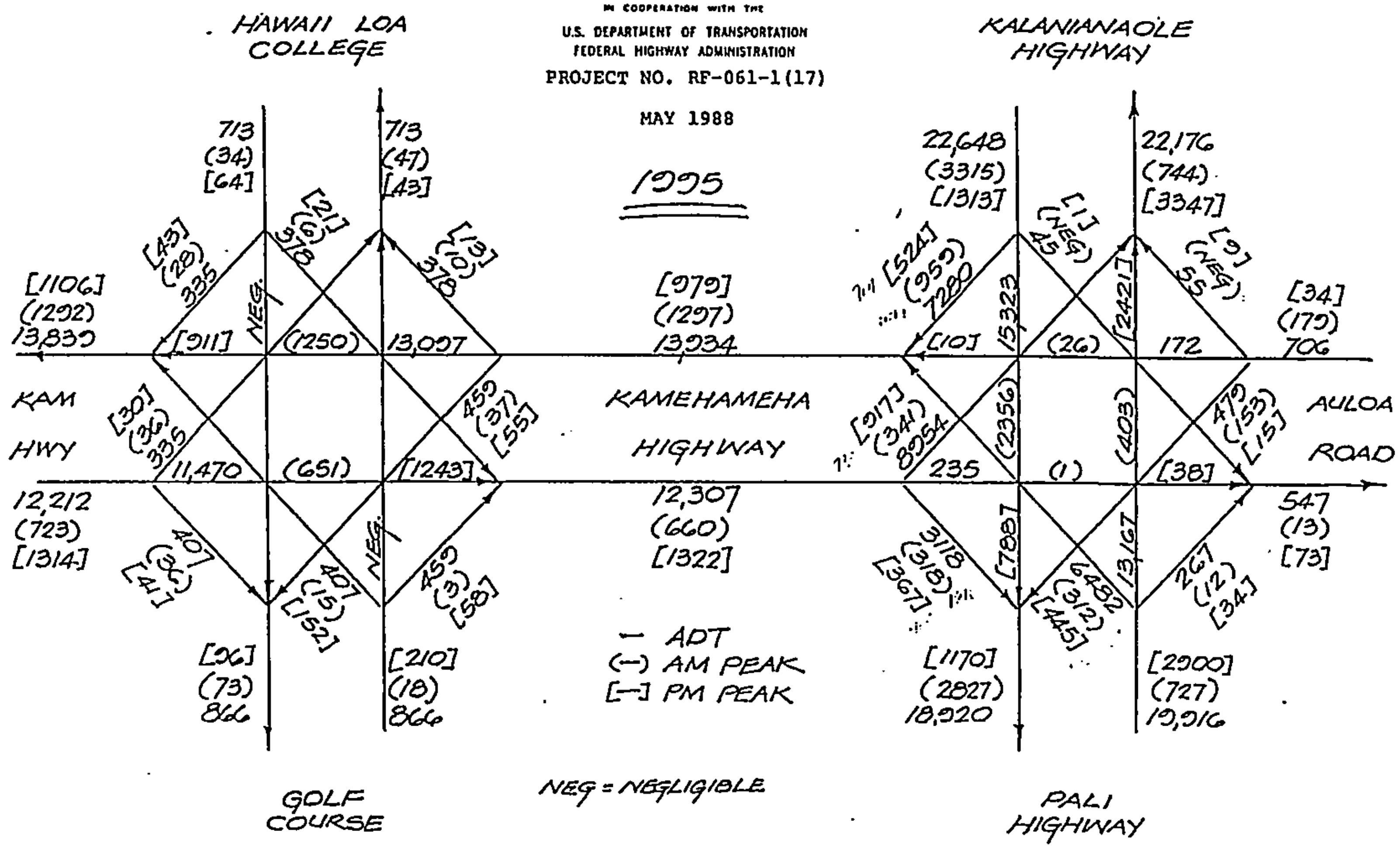
MAY 1988



TRAFFIC ASSIGNMENT PROJ? ¯\ TA 88-5
CASTLE JUNCTION INTERCHANGE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
PREPARED BY THE
PLANNING BRANCH
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
PROJECT NO. RF-061-1(17)

MAY 1988

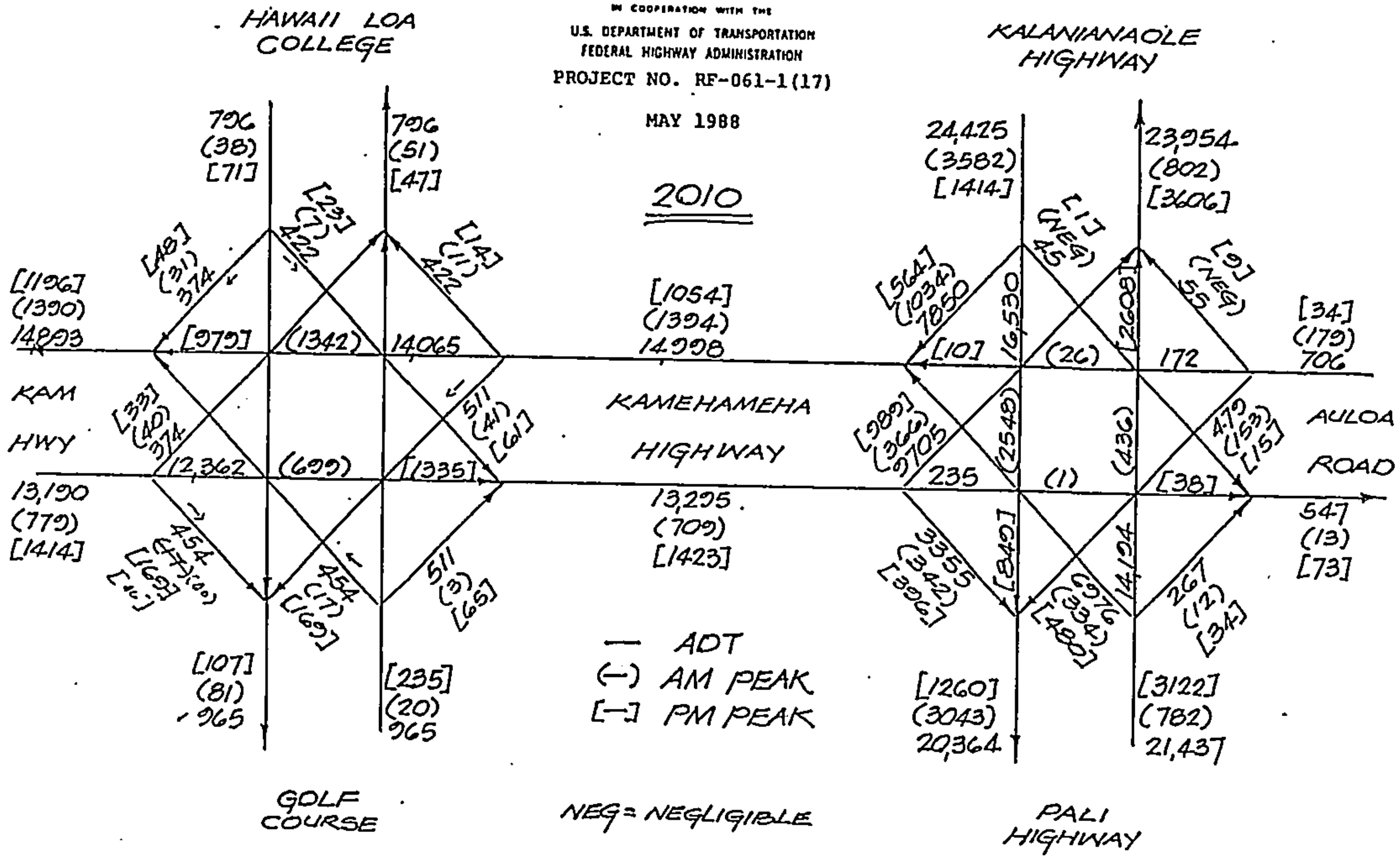


3 OF 5

TRAFFIC ASSIGNMENT PROJE/ 'TA 88-5
CASTLE JUNCTION INTERCHANGE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
PREPARED BY THE
PLANNING BRANCH
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
PROJECT NO. RF-061-1(17)

MAY 1988



CASTLE JUNCTION INTERCHANGE
PROJECT NO. RF-061-1(17)

DESIGN FACTORS

FACILITY	AM PEAK K	AM PEAK D	AM PEAK T	PM PEAK K	PM PEAK D	PM PEAK T	PEAK 8-HR K	PEAK 8-HR D	PEAK 8-HR T	T_{24}
KALANIANAOLE & PALI HIGHWAYS	9.0	80/20	2.0	10.5	70/30	1.5	47.5	60/40	4.0	2.5
KAMEHAMEHA HIGHWAY	7.5	65/35	4.0	9.0	55/45	2.0	52.0	55/45	4.0	3.5

PERCENT BREAKDOWN OF VEHICLES FOR NOISE STUDIES

VEHICLE TYPE	KALANIANAOLE & PALI HIGHWAYS AM PEAK	KALANIANAOLE & PALI HIGHWAYS PM PEAK	KAMEHAMEHA HIGHWAY AM PEAK	KAMEHAMEHA HIGHWAY PM PEAK
AUTOMOBILE	98.3	98.9	97.1	98.7
MEDIUM TRUCK	0.4	0.3	2.0	0.4
HEAVY TRUCK	1.3	0.8	0.9	0.9

PERCENT BREAKDOWN OF TRUCKS FOR AIR QUALITY STUDIES

TRUCK TYPE	KALANIANAOLE & PALI HIGHWAYS AM PEAK	KALANIANAOLE & PALI HIGHWAYS PM PEAK	KALANIANAOLE & PALI HIGHWAYS PEAK 8-HOUR	KAMEHAMEHA HIGHWAY AM PEAK	KAMEHAMEHA HIGHWAY PM PEAK	KAMEHAMEHA HIGHWAY PEAK 8-HOUR
LESS THAN 6000 LBS	16.7	32.3	20.5	10.0	25.7	22.3
6000-8500 LBS GAS	1.8	1.6	1.4	0	0	1.8
8500 LBS + GAS	25.1	23.8	21.9	30.0	25.7	24.9
8500 LBS + DIESEL	56.4	42.3	56.2	60.0	48.6	51.0

REF NO.

APPENDIX C

LEVEL OF SERVICE CALCULATIONS FOR 1995 AND 2010 CONDITIONS

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT
****
INTERSECTION..KAMEHAMEHA HWY/PALI/KALANIANIOLE HWY
AREA TYPE.....OTHER
ANALYST.......SR
DATE..........4/11/90
TIME..........1988 AM PEAK HOUR
COMMENT.....KPBBAM

VOLUMES : GEOMETRY

	EB	WB	NB	SB	:	EB		WB		NB		SB	
LT	159	100	168	0	:	L	12.0	L	12.0	L	12.0	L	12.0
TH	0	50	590	1897	:	LT	12.0	TR	12.0	T	12.0	T	12.0
RT	1155	0	0	443	:	R	12.0		12.0	T	12.0	T	12.0
RR	173	0	0	89	:		12.0		12.0	R	12.0	R	12.0
					:		12.0		12.0		12.0		12.0
					:		12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.90	50	N	31.8	3
WB	0.00	2.00	N	0	0	0.90	50	N	31.8	3
NB	0.00	2.00	N	0	0	0.90	50	N	22.8	3
SB	0.00	2.00	N	0	0	0.90	50	N	22.8	3

SIGNAL SETTINGS CYCLE LENGTH = 100.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT	X	X		
	TH	X					TH		X	X	
	RT	X					RT		X	X	
	PD						PD				
WB	LT	X				SB	LT	X			
	TH	X					TH			X	
	RT	X					RT			X	
	PD						PD				
GREEN		10.0	0.0	0.0	0.0	GREEN		5.0	8.0	62.0	0.0
YELLOW		4.0	0.0	0.0	0.0	YELLOW		3.0	4.0	4.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.400	0.110	32.3	D	*	*
	LT	0.582	0.110	30.2	D		
	R	4.503	0.160	*	*		
WB	L	1.559	0.110	*	*	*	*
	TR	0.283	0.110	26.6	D		
NB	L	0.649	0.170	32.9	D	9.0	B
	T	0.258	0.750	2.5	A		
	R	0.000	0.750	3.3	A		
SB	L	0.000	0.050	30.0	D	19.4	C
	T	0.986	0.630	21.8	C		
	R	0.412	0.630	6.1	B		

INTERSECTION: Delay = * (sec/veh) V/C = 1.595 LOS = *

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT
****
INTERSECTION..KAMEHAMEHA HWY/PALI/KALANIANIOLE HWY
AREA TYPE.....OTHER
ANALYST.......SR
DATE..........4/11/90
TIME..........1988 PM PEAK HOUR
COMMENT.....KP88PM

	VOLUMES EB	WB	NB	SB	:	GEOMETRY EB		WB		NB		SB	
LT	402	10	1134	0	:	L	12.0	L	12.0	L	12.0	L	12.0
TH	20	10	1810	621	:	LT	12.0	TR	12.0	T	12.0	T	12.0
RT	592	10	50	533	:	R	12.0		12.0	T	12.0	T	12.0
RR	592	0	0	267	:		12.0		12.0	R	12.0	R	12.0
					:		12.0		12.0		12.0		12.0
					:		12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.90	50	N	31.8	3
WB	0.00	2.00	N	0	0	0.90	50	N	31.8	3
NB	0.00	2.00	N	0	0	0.90	50	N	22.8	3
SB	0.00	2.00	N	0	0	0.90	50	N	22.8	3

SIGNAL SETTINGS CYCLE LENGTH = 100.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT	X	X		
	TH	X					TH		X	X	
	RT	X					RT		X	X	
	PD						PD				
WB	LT	X				SB	LT	X			
	TH	X					TH			X	
	RT	X					RT			X	
	PD						PD				
GREEN		15.0	0.0	0.0	0.0	GREEN		5.0	44.0	21.0	0.0
YELLOW		4.0	0.0	0.0	0.0	YELLOW		3.0	4.0	4.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.262	0.160	28.1	D	*	*
	LT	1.430	0.160	*	*		
	R	0.000	0.210	21.2	C		
WB	L	0.156	0.160	27.6	D	24.4	C
	TR	0.084	0.160	23.1	C		
NB	L	1.404	0.530	*	*	*	*
	T	0.846	0.700	8.9	B		
	R	0.052	0.700	3.0	A		
SB	L	0.000	0.050	30.0	D	35.9	D
	T	0.924	0.220	34.8	D		
	R	0.886	0.220	38.4	D		

INTERSECTION: Delay = * (sec/veh) V/C = 1.293 LOS = *

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..KAMEHAMEHA HWY/PALI/KALANIANIOLE HWY
AREA TYPE.....OTHER
ANALYST.......SR
DATE..........4/11/90
TIME..........1995 AM PEAK HOUR
COMMENT.....KP 75AM

VOLUMES

	EB	WB	NB	SB
LT	341	153	312	0
TH	1	26	403	2356
RT	318	0	12	959
RR	318	0	0	959

GEOMETRY

EB		WB		NB		SB	
L	12.0	L	12.0	L	12.0	L	12.0
LT	12.0	TR	12.0	T	12.0	T	12.0
R	12.0		12.0	T	12.0	T	12.0
	12.0		12.0	R	12.0	R	12.0
	12.0		12.0		12.0		12.0
	12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ PKG Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. BUT. Y/N	min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.90	50	N	31.8	3
WB	0.00	2.00	N	0	0	0.90	50	N	31.8	3
NB	0.00	2.00	N	0	0	0.90	50	N	22.8	3
SB	0.00	2.00	N	0	0	0.90	50	N	22.8	3

SIGNAL SETTINGS CYCLE LENGTH = 100.0

		PH-1	PH-2	PH-3	PH-4
EB	LT	X			
	TH	X			
	RT	X			
	PD				
WB	LT	X			
	TH	X			
	RT	X			
	PD				
GREEN		13.0	0.0	0.0	0.0
YELLOW		4.0	0.0	0.0	0.0

		PH-1	PH-2	PH-3	PH-4
NB	LT	X	X		
	TH		X	X	
	RT		X	X	
	PD				
SB	LT	X			
	TH			X	
	RT			X	
	PD				
GREEN		5.0	16.0	51.0	0.0
YELLOW		3.0	4.0	4.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.297	0.140	29.5	D	*	*
	LT	1.271	0.140	*	*		
	R	0.001	0.190	21.2	C		
WB	L	2.365	0.140	*	*	*	*
	TR	0.116	0.140	24.3	C		
NB	L	0.819	0.250	35.2	D	16.4	C
	T	0.183	0.720	2.9	A		
	R	0.012	0.720	2.6	A		
SB	L	0.000	0.050	30.0	D	*	*
	T	1.483	0.520	*	*		
	R	0.000	0.520	6.1	B		

INTERSECTION: Delay = * (sec/veh) V/C = 1.439 LOS = *

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT
****
INTERSECTION..KAMEHAMEHA HWY/PALI/KALANIANIOLE HWY
AREA TYPE.....OTHER
ANALYST.......ER
DATE..........4/11/90
TIME..........1995 PM PEAK HOUR
COMMENT.....KP95PM

	VOLUMES					GEOMETRY							
	EB	WB	NB	SB		EB		WB		NB		SB	
LT	917	15	445	1	L	12.0	L	12.0	L	12.0	L	12.0	
TH	38	10	2421	788	LT	12.0	TR	12.0	T	12.0	T	12.0	
RT	367	9	34	524	R	12.0		12.0	T	12.0	T	12.0	
RR	592	0	0	267		12.0		12.0	R	12.0	R	12.0	
						12.0		12.0		12.0		12.0	
						12.0		12.0		12.0		12.0	

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ PKG Y/N	Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.90	50	N	31.8	3
WB	0.00	2.00	N	0	0	0.90	50	N	31.8	3
NB	0.00	2.00	N	0	0	0.90	50	N	22.8	3
SB	0.00	2.00	N	0	0	0.90	50	N	22.8	3

SIGNAL SETTINGS CYCLE LENGTH = 100.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT	X	X		
	TH	X					TH		X	X	
	RT	X					RT		X	X	
	PD						PD				
WB	LT	X				SB	LT	X			
	TH	X					TH			X	
	RT	X					RT			X	
	PD						PD				
GREEN		15.0	0.0	0.0	0.0	GREEN		5.0	44.0	21.0	0.0
YELLOW		4.0	0.0	0.0	0.0	YELLOW		3.0	4.0	4.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.261	0.160	28.1	D	*	*
	LT	3.559	0.160	*	*		
	R	0.000	0.210	21.2	C		
WB	L	0.234	0.160	28.2	D	25.1	D
	TR	0.080	0.160	23.1	C		
NB	L	0.551	0.530	12.4	B	59.6	E
	T	1.132	0.700	68.6	F		
	R	0.036	0.700	3.0	A		
SB	L	0.013	0.050	34.3	D	90.9	F
	T	1.172	0.220	108.2	F		
	R	0.856	0.220	35.5	D		

INTERSECTION: Delay = * (sec/veh) V/C = 1.497 LOS = *

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT
****
INTERSECTION..KAMEHAMEHA HWY/PALI/KALANIANIOLE HWY
AREA TYPE.....OTHER
ANALYST.......SR
DATE..........4/11/90
TIME..........2010 AM PEAK HOUR
COMMENT.....KP2010AMSS

VOLUMES	EB	WB	NB	SB
LT	366	153	334	0
TH	1	26	436	2548
RT	342	0	12	1034
RR	342	0	0	1034

GEOMETRY

EB		WB		NB		SB	
L	12.0	L	12.0	L	12.0	L	12.0
LT	12.0	TR	12.0	T	12.0	T	12.0
R	12.0		12.0	T	12.0	T	12.0
	12.0		12.0	R	12.0	R	12.0
	12.0		12.0		12.0		12.0
	12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ PKG Y/N	Nm	BUSES Nb	PHF	PEDS	PED. BUT. Y/N	min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.90	50	N	31.8	3
WB	0.00	2.00	N	0	0	0.90	50	N	31.8	3
NB	0.00	2.00	N	0	0	0.90	50	N	22.8	3
SB	0.00	2.00	N	0	0	0.90	50	N	22.8	3

SIGNAL SETTINGS CYCLE LENGTH = 100.0

		PH-1	PH-2	PH-3	PH-4
EB	LT	X			
	TH	X			
	RT	X			
	PD				
WB	LT	X			
	TH	X			
	RT	X			
	PD				
GREEN		13.0	0.0	0.0	0.0
YELLOW		4.0	0.0	0.0	0.0

		PH-1	PH-2	PH-3	PH-4
NB	LT	X	X		
	TH		X	X	
	RT		X	X	
	PD				
SB	LT	X			
	TH			X	
	RT			X	
	PD				
GREEN		5.0	18.0	49.0	0.0
YELLOW		3.0	4.0	4.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.297	0.140	29.5	D	*	*
	LT	1.385	0.140	*	*		
	R	0.000	0.190	21.2	C		
WB	L	2.385	0.140	*	*	*	*
	TR	0.116	0.140	24.3	C		
NB	L	0.812	0.270	33.3	D	15.6	C
	T	0.198	0.720	3.0	A		
	R	0.012	0.720	2.6	A		
SB	L	0.000	0.050	30.0	D	*	*
	T	1.668	0.500	*	*		
	R	0.000	0.500	6.1	B		

INTERSECTION: Delay = * (sec/veh) V/C = 1.524 LOS = *

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..KAMEHAMEHA HWY/PALI/KALANIANIOLE HWY
AREA TYPE.....OTHER
ANALYST.......SR
DATE..........4/11/90
TIME..........2010 PM PEAK HOUR
COMMENT.....KP2010PM

	VOLUMES EB	WB	NB	SB	GEOMETRY EB		WB		NB		SB	
LT	989	15	480	1	L	12.0	L	12.0	L	12.0	L	12.0
TH	38	10	2608	849	LT	12.0	TR	12.0	T	12.0	T	12.0
RT	396	9	34	564	R	12.0		12.0	T	12.0	T	12.0
RR	396	0	0	564		12.0		12.0	R	12.0	R	12.0
						12.0		12.0		12.0		12.0
						12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. BUT. Y/N	min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.90	50	N	31.8	3
WB	0.00	2.00	N	0	0	0.90	50	N	31.8	3
NB	0.00	2.00	N	0	0	0.90	50	N	22.8	3
SB	0.00	2.00	N	0	0	0.90	50	N	22.8	3

SIGNAL SETTINGS CYCLE LENGTH = 100.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT	X	X		
	TH	X					TH		X	X	
	RT	X					RT		X	X	
	PD						PD				
WB	LT	X				SB	LT	X			
	TH	X					TH			X	
	RT	X					RT			X	
	PD						PD				
GREEN		15.0	0.0	0.0	0.0	GREEN		5.0	44.0	21.0	0.0
YELLOW		4.0	0.0	0.0	0.0	YELLOW		3.0	4.0	4.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.261	0.160	28.1	D	*	*
	LT	3.849	0.160	*	*		
	R	0.000	0.210	21.2	C		
WB	L	0.234	0.160	28.2	D	25.1	D
	TR	0.080	0.160	23.1	C		
NB	L	0.594	0.530	13.0	B	*	*
	T	1.220	0.700	*	*		
	R	0.036	0.700	3.0	A		
SB	L	0.013	0.050	34.3	D	*	*
	T	1.263	0.220	*	*		
	R	0.000	0.220	35.5	D		

INTERSECTION: Delay = * (sec/veh) V/C = 1.616 LOS = *

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1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT
***************************************************************************
INTERSECTION..KAMEHAMEHA HWY/COLLEGE/GOLF ENTRANCE
AREA TYPE.....CBD
ANALYST.......SR
DATE..........4/11/90
TIME..........1988 AM PEAK HOUR
COMMENT.......HK88AM
---------------------------------------------------------------------------
           VOLUMES           :                     GEOMETRY
       EB    WB    NB    SB  :      EB          WB          NB          SB
LT     32    37    11     5  : L   12.0    L   12.0   L   12.0   L   12.0
TH   1306   615     0     0  : T   12.0    T   12.0   R   12.0   R   12.0
RT     27     9     3    25  : T   12.0    T   12.0       12.0       12.0
RR     27     9     0     0  : R   12.0    R   12.0       12.0       12.0
                             :     12.0        12.0       12.0       12.0
                             :     12.0        12.0       12.0       12.0
---------------------------------------------------------------------------
                           ADJUSTMENT FACTORS
     GRADE    HV    ADJ PKG  BUSES   PHF   PEDS   PED. BUT.    ARR. TYPE
      (%)     (%)   Y/N  Nm   Nb                  Y/N  min T
EB    0.00   2.00    N    0    0    0.90    50     N   19.8        3
WB    0.00   2.00    N    0    0    0.90    50     N   19.8        3
NB    0.00   2.00    N    0    0    0.90    50     N   31.8        3
SB    0.00   2.00    N    0    0    0.90    50     N   31.8        3
---------------------------------------------------------------------------
                           SIGNAL SETTINGS          CYCLE LENGTH = 100.0
         PH-1   PH-2   PH-3   PH-4                PH-1   PH-2   PH-3   PH-4
EB  LT     X                         NB  LT        X
    TH            X                      TH
    RT            X                      RT        X
    PD                                   PD
WB  LT     X                         SB  LT        X
    TH            X                      TH
    RT            X                      RT        X
    PD                                   PD
GREEN    10.0   68.0    0.0    0.0   GREEN       10.0    0.0    0.0    0.0
YELLOW    4.0    4.0    0.0    0.0   YELLOW       4.0    0.0    0.0    0.0
---------------------------------------------------------------------------
                           LEVEL OF SERVICE
     LANE GRP.   V/C     G/C     DELAY   LOS   APP. DELAY    APP. LOS
EB      L       0.212   0.110    30.9     D       7.0            B
        T       0.688   0.690     6.5     B
        R       0.000   0.800     1.3     A
WB      L       0.245   0.110    31.1     D       5.5            B
        T       0.324   0.690     4.0     A
        R       0.000   0.800     1.3     A
NB      L       0.073   0.110    30.3     D      28.1            D
        R       0.011   0.220    19.7     C
SB      L       0.033   0.110    30.2     D      21.8            C
        R       0.093   0.220    20.1     C
---------------------------------------------------------------------------
INTERSECTION:      Delay =    6.9 (sec/veh)    V/C = 0.574     LOS = B
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1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT
****
INTERSECTION..KAMEHAMEHA HWY/COLLEGE/GOLF ENTRANCE
AREA TYPE.....CBD
ANALYST.......SF
DATE..........4/11/90
TIME..........1988 PM PEAK HOUR
COMMENT.......HK88PM

	VOLUMES				:	GEOMETRY							
	EB	WB	NB	SB	:	EB		WB		NB		SB	
LT	27	55	125	18	:	L	12.0	L	12.0	L	12.0	L	12.0
TH	937	1611	0	0	:	T	12.0	T	12.0	R	12.0	R	12.0
RT	30	11	59	38	:	T	12.0	T	12.0		12.0		12.0
RR	30	11	0	0	:	R	12.0	R	12.0		12.0		12.0
					:		12.0		12.0		12.0		12.0
					:		12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ PKG Y/N	Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.90	50	N	14.5	3
WB	0.00	2.00	N	0	0	0.90	50	N	14.5	3
NB	0.00	2.00	N	0	0	0.90	50	N	26.5	3
SB	0.00	2.00	N	0	0	0.90	50	N	26.5	3

SIGNAL SETTINGS CYCLE LENGTH = 100.0

		PH-1	PH-2	PH-3	PH-4
EB	LT	X			
	TH		X		
	RT		X		
	PD				
WB	LT	X			
	TH		X		
	RT		X		
	PD				
GREEN		10.0	67.0	0.0	0.0
YELLOW		4.0	4.0	0.0	0.0

		PH-1	PH-2	PH-3	PH-4
NB	LT	X			
	TH				
	RT	X			
	PD				
SB	LT	X			
	TH				
	RT	X			
	PD				
GREEN		11.0	0.0	0.0	0.0
YELLOW		4.0	0.0	0.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.179	0.110	30.8	D	5.8	B
	T	0.501	0.680	5.2	B		
	R	0.000	0.800	1.3	A		
WB	L	0.365	0.110	32.0	D	11.0	B
	T	0.862	0.680	10.3	B		
	R	0.000	0.800	1.3	A		
NB	L	0.766	0.120	44.1	E	36.4	D
	R	0.209	0.230	20.2	C		
SB	L	0.109	0.120	29.8	D	23.0	C
	R	0.135	0.230	19.8	C		

INTERSECTION: Delay = 11.0 (sec/veh) V/C = 0.789 LOS = B

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT
****

INTERSECTION..KAMEHAMEHA HWY/COLLEGE/GOLF ENTRANCE
AREA TYPE.....CBD
ANALYST.......SR
DATE..........4/11/90
TIME..........1995 AM PEAK HOUR
COMMENT.......HK95AM

	VOLUMES EB	WB	NB	SB	GEOMETRY EB		WB		NB		SB	
LT	36	37	15	6	L	12.0	L	12.0	L	12.0	L	12.0
TH	651	1250	0	0	T	12.0	T	12.0	R	12.0	R	12.0
RT	36	10	3	28	T	12.0	T	12.0		12.0		12.0
RR	27	9	0	0	R	12.0	R	12.0		12.0		12.0
						12.0		12.0		12.0		12.0
						12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ PKG Y/N	Nm	BUSES Nb	PHF	PEDS	PED. BUT. Y/N	min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.90	50	N	19.8	3
WB	0.00	2.00	N	0	0	0.90	50	N	19.8	3
NB	0.00	2.00	N	0	0	0.90	50	N	31.8	3
SB	0.00	2.00	N	0	0	0.90	50	N	31.8	3

SIGNAL SETTINGS   CYCLE LENGTH = 100.0

		PH-1	PH-2	PH-3	PH-4
EB	LT	X			
	TH		X		
	RT		X		
	PD				
WB	LT	X			
	TH		X		
	RT		X		
	PD				
GREEN		10.0	68.0	0.0	0.0
YELLOW		4.0	4.0	0.0	0.0

		PH-1	PH-2	PH-3	PH-4
NB	LT	X			
	TH				
	RT	X			
	PD				
SB	LT	X			
	TH				
	RT	X			
	PD				
GREEN		10.0	0.0	0.0	0.0
YELLOW		4.0	0.0	0.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.239	0.110	31.1	D	5.4	B
	T	0.343	0.690	4.1	A		
	R	0.009	0.800	1.3	A		
WB	L	0.245	0.110	31.1	D	6.8	B
	T	0.659	0.690	6.1	B		
	R	0.001	0.800	1.3	A		
NB	L	0.099	0.110	30.4	D	28.7	D
	R	0.011	0.220	19.7	C		
SB	L	0.040	0.110	30.2	D	21.9	C
	R	0.104	0.220	20.1	C		

INTERSECTION: Delay = 6.8 (sec/veh)   V/C = 0.554   LOS = B

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

INTERSECTION..KAMEHAMEHA HWY/COLLEGE/GOLF ENTRANCE
AREA TYPE.....CBD
ANALYST.......SR
DATE..........4/11/90
TIME..........1995 PM PEAK HOUR
COMMENT.......HK95PM

VOLUMES

	EB	WB	NB	SB
LT	30	55	152	21
TH	1243	911	0	0
RT	41	13	59	43
RR	30	11	0	0

GEOMETRY

EB		WB		NB		SB	
L	12.0	L	12.0	L	12.0	L	12.0
T	12.0	T	12.0	R	12.0	R	12.0
T	12.0	T	12.0		12.0		12.0
R	12.0	R	12.0		12.0		12.0
	12.0		12.0		12.0		12.0
	12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ PKG Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. BUT. Y/N	min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.90	50	N	14.5	3
WB	0.00	2.00	N	0	0	0.90	50	N	14.5	3
NB	0.00	2.00	N	0	0	0.90	50	N	26.5	3
SB	0.00	2.00	N	0	0	0.90	50	N	26.5	3

SIGNAL SETTINGS CYCLE LENGTH = 100.0

		PH-1	PH-2	PH-3	PH-4
EB	LT	X			
	TH		X		
	RT		X		
	PD				
WB	LT	X			
	TH		X		
	RT		X		
	PD				
GREEN		10.0	67.0	0.0	0.0
YELLOW		4.0	4.0	0.0	0.0

		PH-1	PH-2	PH-3	PH-4
NB	LT	X			
	TH				
	RT	X			
	PD				
SB	LT	X			
	TH				
	RT	X			
	PD				
GREEN		11.0	0.0	0.0	0.0
YELLOW		4.0	0.0	0.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.199	0.110	30.9	D	7.0	B
	T	0.665	0.680	6.5	B		
	R	0.012	0.800	1.3	A		
WB	L	0.365	0.110	32.0	D	6.5	B
	T	0.487	0.680	5.1	B		
	R	0.002	0.800	1.3	A		
NB	L	0.924	0.120	65.3	F	52.7	E
	R	0.209	0.230	20.2	C		
SB	L	0.128	0.120	29.9	D	23.2	C
	R	0.152	0.230	19.9	C		

INTERSECTION: Delay = 10.9 (sec/veh) V/C = 0.663 LOS = B

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..KAMEHAMEHA HWY/COLLEGE/GOLF ENTRANCE
AREA TYPE.....CBD
ANALYST.......SR
DATE..........4/11/90
TIME..........2010 AM PEAK HOUR
COMMENT.......HK2010AM

VOLUMES

	EB	WB	NB	SB
LT	40	41	17	7
TH	699	1342	0	0
RT	40	11	3	31
RR	40	11	0	0

GEOMETRY

EB		WB		NB		SB	
L	12.0	L	12.0	L	12.0	L	12.0
T	12.0	T	12.0	R	12.0	R	12.0
T	12.0	T	12.0		12.0		12.0
R	12.0	R	12.0		12.0		12.0
	12.0		12.0		12.0		12.0
	12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. BUT. Y/N	min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.90	50	N	19.8	3
WB	0.00	2.00	N	0	0	0.90	50	N	19.8	3
NB	0.00	2.00	N	0	0	0.90	50	N	31.8	3
SB	0.00	2.00	N	0	0	0.90	50	N	31.8	3

SIGNAL SETTINGS

CYCLE LENGTH = 100.0

		PH-1	PH-2	PH-3	PH-4
EB	LT	X			
	TH		X		
	RT		X		
	PD				
WB	LT	X			
	TH		X		
	RT		X		
	PD				
GREEN		10.0	68.0	0.0	0.0
YELLOW		4.0	4.0	0.0	0.0

		PH-1	PH-2	PH-3	PH-4
NB	LT	X			
	TH				
	RT	X			
	PD				
SB	LT	X			
	TH				
	RT	X			
	PD				
GREEN		10.0	0.0	0.0	0.0
YELLOW		4.0	0.0	0.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.265	0.110	31.2	D	5.6	B
	T	0.368	0.690	4.2	A		
	R	0.000	0.800	1.3	A		
WB	L	0.272	0.110	31.3	D	7.4	B
	T	0.707	0.690	6.7	B		
	R	0.000	0.800	1.3	A		
NB	L	0.113	0.110	30.5	D	28.9	D
	R	0.011	0.220	19.7	C		
SB	L	0.046	0.110	30.3	D	22.0	C
	R	0.115	0.220	20.2	C		

INTERSECTION: Delay = 7.2 (sec/veh) V/C = 0.597 LOS = B

1985 HCM: SIGNALIZED INTERSECTIONS
SUMMARY REPORT

****

INTERSECTION..KAMEHAMEHA HWY/COLLEGE/GOLF ENTRANCE
AREA TYPE.....CBD
ANALYST.......SR
DATE..........4/11/90
TIME..........1995 PM PEAK HOUR
COMMENT.......HK2010PM

	VOLUMES				:	GEOMETRY							
	EB	WB	NB	SB	:	EB		WB		NB		SB	
LT	33	61	169	23	:	L	12.0	L	12.0	L	12.0	L	12.0
TH	1335	979	0	0	:	T	12.0	T	12.0	R	12.0	R	12.0
RT	46	14	65	48	:	T	12.0	T	12.0		12.0		12.0
RR	30	11	0	0	:	R	12.0	R	12.0		12.0		12.0
					:		12.0		12.0		12.0		12.0
					:		12.0		12.0		12.0		12.0

ADJUSTMENT FACTORS

	GRADE (%)	HV (%)	ADJ Y/N	PKG Nm	BUSES Nb	PHF	PEDS	PED. Y/N	BUT. min T	ARR. TYPE
EB	0.00	2.00	N	0	0	0.90	50	N	14.5	3
WB	0.00	2.00	N	0	0	0.90	50	N	14.5	3
NB	0.00	2.00	N	0	0	0.90	50	N	26.5	3
SB	0.00	2.00	N	0	0	0.90	50	N	26.5	3

SIGNAL SETTINGS CYCLE LENGTH = 100.0

		PH-1	PH-2	PH-3	PH-4			PH-1	PH-2	PH-3	PH-4
EB	LT	X				NB	LT	X			
	TH		X				TH				
	RT		X				RT	X			
	PD						PD				
WB	LT	X				SB	LT	X			
	TH		X				TH				
	RT		X				RT	X			
	PD						PD				
GREEN		10.0	67.0	0.0	0.0	GREEN		11.0	0.0	0.0	0.0
YELLOW		4.0	4.0	0.0	0.0	YELLOW		4.0	0.0	0.0	0.0

LEVEL OF SERVICE

	LANE GRP.	V/C	G/C	DELAY	LOS	APP. DELAY	APP. LOS
EB	L	0.219	0.110	31.0	D	7.6	B
	T	0.714	0.680	7.1	B		
	R	0.017	0.800	1.3	A		
WB	L	0.404	0.110	32.4	D	6.8	B
	T	0.524	0.680	5.3	B		
	R	0.003	0.800	1.3	A		
NB	L	1.027	0.120	93.4	F	73.1	F
	R	0.230	0.230	20.3	C		
SB	L	0.140	0.120	30.0	D	23.2	C
	R	0.170	0.230	20.0	C		

INTERSECTION: Delay = 13.1 (sec/veh) V/C = 0.718 LOS = B

APPENDIX D

HDOT DESIGN STANDARDS

Table 2-3

General Design Controls for Urban Streets and Highways

Highway Type	Arterial	Collector	Local
Design Speed, MPH	Urban 25-45 Suburban 25-60	25-35	15-30
Level of Service	C	C	---
Design Vehicle	SU; WB-50	SU; WB-50	SU
Design-Hourly Volume, DHV	As Furnished	As Furnished	---
Number of Lanes	2 to 6	2 to 4	2
Lane Width, Feet	12 Desirable 11 Minimum	12 Desirable 10 Minimum	10-12
Median Width (If Applicable)	4' Minimum	---	---
Shoulder Width, Feet	10 Right 4 Left	Usually Curbed	Usually Curbed
Max. Superelevation, Percent	6	4	---
Curve Radius	Fig. 4-G	Fig. 4-G	Fig. 4-G
Stopping Sight Distance	Table 4-1	Table 4-1	Table 4-1
Passing Sight Distance	Table 4-1	Table 4-1	Table 4-1
Profile Grade, %	Table 9-3	4 Level 12 Rolling/Mt.	15 Max.

Table 2-4

General Design Controls for Rural Roads and Highways

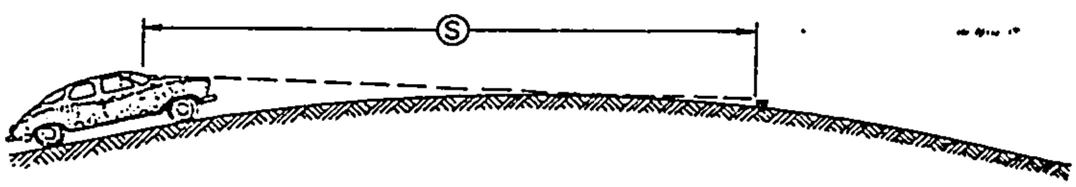
Highway Type	Arterial	Collector	Local
Design Speed, MPH	Level 50-60 Rolling 45-60 Mount. 25-45	35-50	20-35
Level of Service	C	C	---
Design Vehicle	SU; WB-50	SU; WB-50	SU
Design-Hourly Volume, DHV	As Furnished	As Furnished	---
Number of Lanes	2 to 6	2 to 4	2
Lane Width, Feet	12 Desirable 11 Minimum	12 Desirable 10 Minimum	10-12
Median Width (If Applicable), Feet	22 Desirable 4 Minimum	22 Desirable 4 Minimum	---
Shoulder Width, Feet	10 Right 4 Left	10 Right 4 Left	8
Max. Superelevation, Percent	8	8	---
Curve Radius	Fig. 4-G	Fig. 4-G	Fig. 4-G
Stopping Sight Distance	Table 4-1	Table 4-1	Table 4-1
Passing Sight Distance	Table 4-1	Table 4-1	Table 4-1
Profile Grade, %	Table 9-1	Table 8-1	15 Max.

Table 2-5

General Design Controls for Freeways

Location	Urban	Rural
Design Speed, MPH	55-80	55-80
Level of Service	C	B
Design Vehicle	SU; WB-50	SU; WB-50
Design-Hourly Volume, DHV	As Furnished	As Furnished
Number of Lanes	4 to 8	4 to 6
Lane Width, Feet	12	12
Median Width (If Applicable)	22' Minimum 46' Desirable	30' Minimum 60' Desirable
Shoulder Width, Feet	10 Right 4-10 Left	10 Right 4-10 Left
Max. Superelevation, %	10	10
Curve Radius	Fig. 4-G	Fig. 4-G
Stopping Sight Distance	Table 4-1	Table 4-1
Passing Sight Distance	Table 4-1	Table 4-1
Profile Grade, %	Table 10-1	Table 10-1

HEIGHT OF EYE 3.50 FEET
HEIGHT OF OBJECT 0.50 FEET

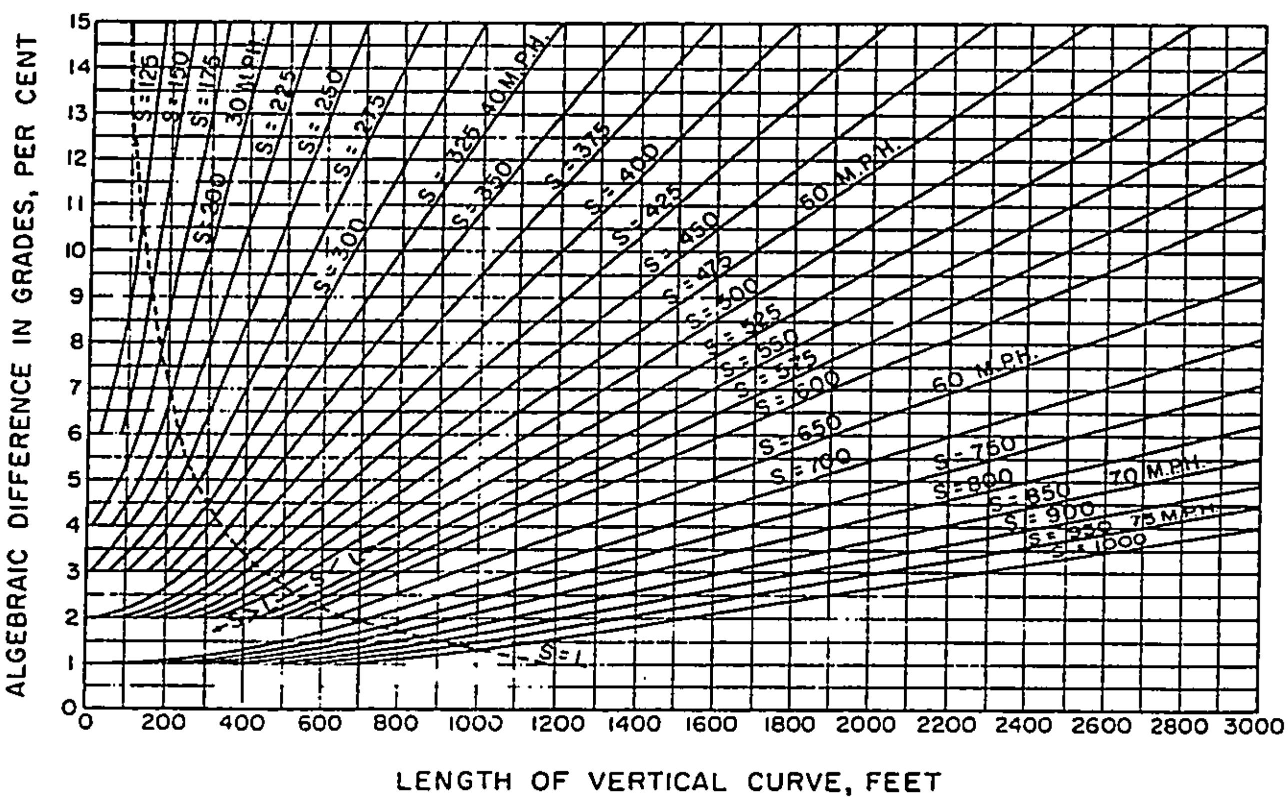


DESIGN SPEED M.P.H.	SIGHT DISTANCE
20	125 FT.
30	200 FT.
40	325 FT.
50	475 FT.
60	650 FT.
65	725 FT.
70	850 FT.

L = CURVE LENGTH - FT.
A = ALGEBRAIC GRADE DIFFERENCE - %
S = SIGHT DISTANCE - FT.
V = DESIGN SPEED - M.P.H. FOR "S"

WHEN S > L: $L = 2S - \frac{1329}{A}$

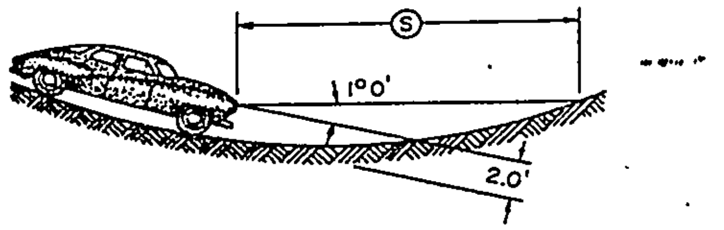
WHEN S < L: $L = \frac{AS^2}{1329}$



STOPPING SIGHT DISTANCE ON CREST VERTICAL CURVES

FIGURE 4-C

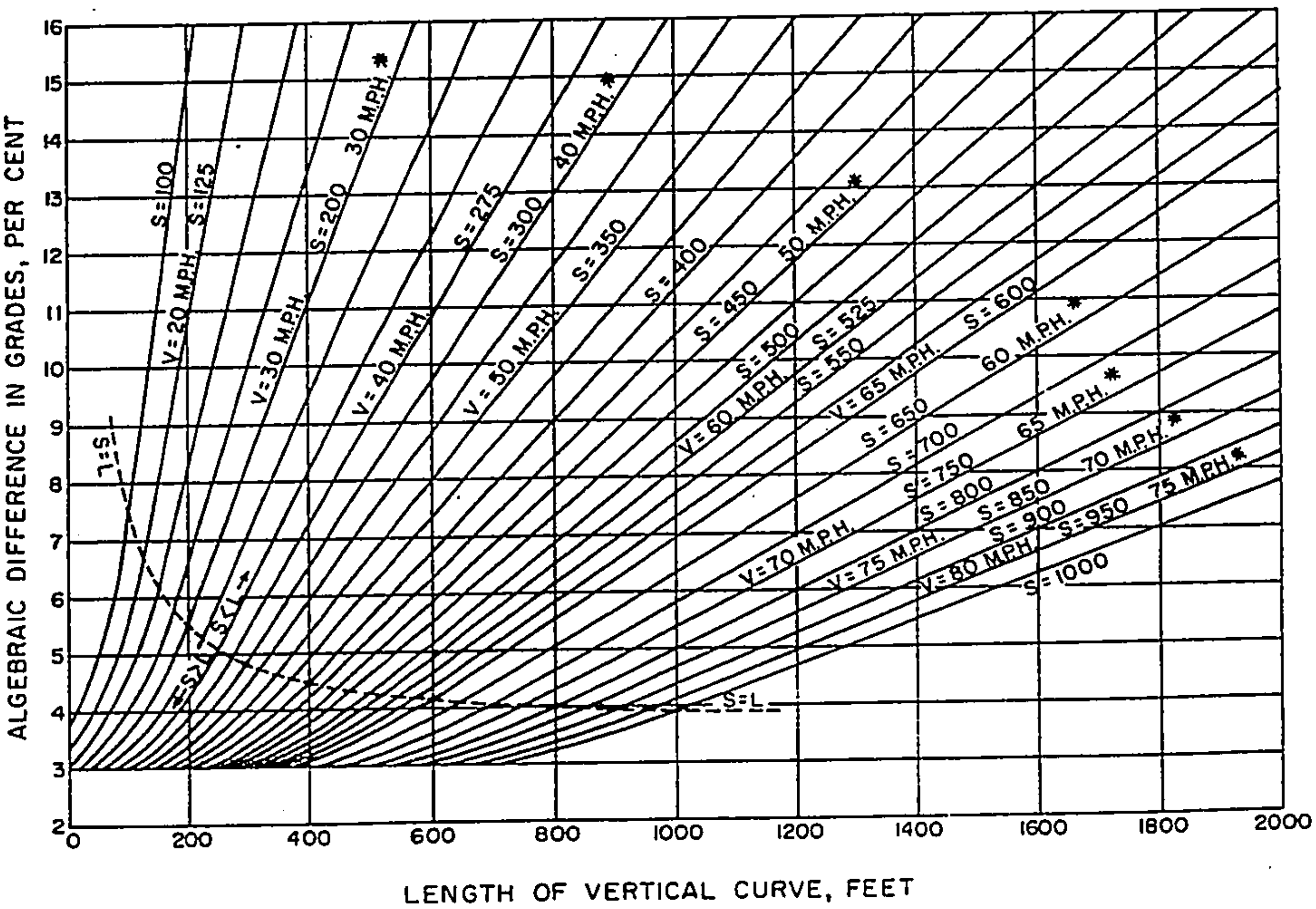
r5/15/86



DESIGN SPEED M.P.H.	SIGHT DISTANCE
20	125 FT.
30	200 FT.
40	325 FT.
50	475 FT.
60	650 FT
65	725 FT.
70	850 FT.

L = CURVE LENGTH - FT.
A = ALGEBRAIC GRADE DIFFERENCE - %
S = SIGHT DISTANCE - FT.
V = DESIGN SPEED - M.P.H. FOR "S"

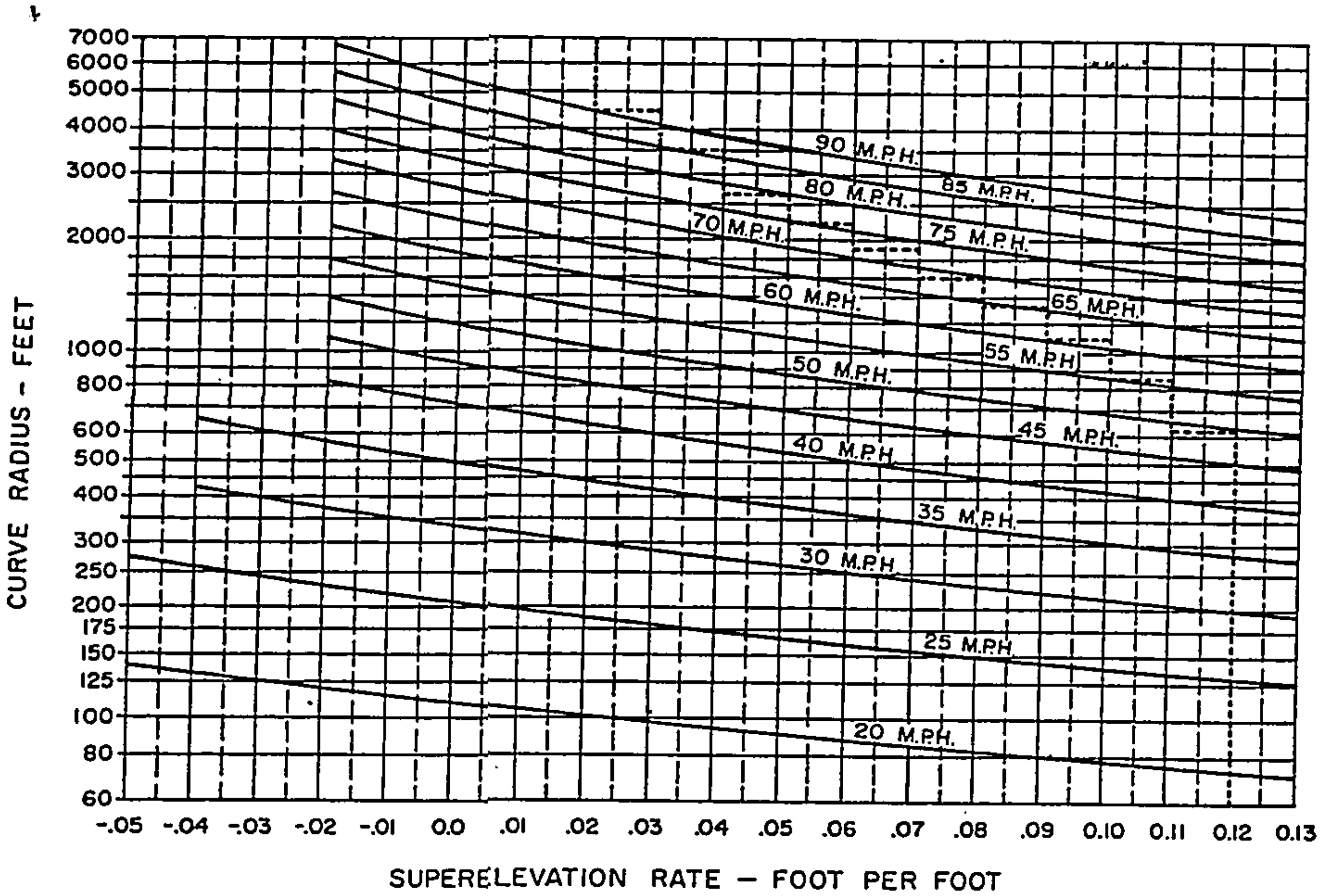
WHEN S > L	WHEN S < L
$L = 2S - \frac{400 + 3.5S}{A}$	$L = \frac{AS^2}{400 + 3.5S}$



STOPPING SIGHT DISTANCE
ON SAG VERTICAL CURVES

FIGURE 4-D

r5/15/86



SPEED	* FRICTION FACTOR
20	0.24
30	0.18
40	0.15
50	0.14
60	0.13
70	0.12
80	0.11
90	0.10 (EXTRAPOLATED)

* THESE FACTORS ARE THE VALUES AT WHICH COMFORT ENDS AND DISCOMFORT BEGINS.

S = SUPERELEVATION
F = FRICTION FACTOR
V = SPEED IN MILES PER HOUR
R = RADIUS IN FEET

$$S + F = \frac{0.067V^2}{R}$$

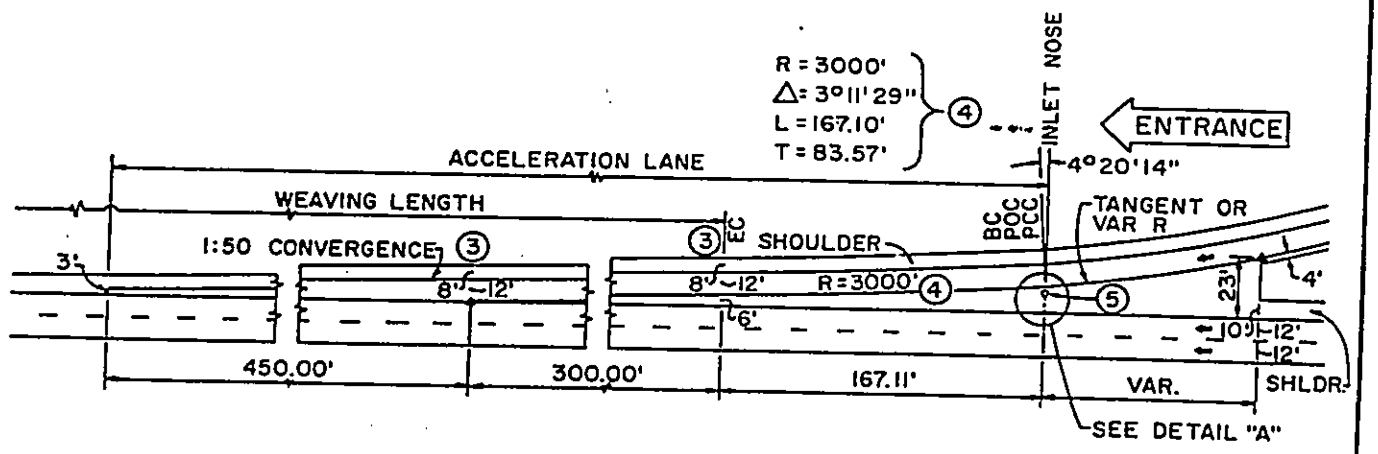
NOTE

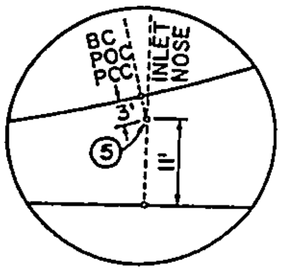
BROKEN LINE INDICATES STANDARD SUPERELEVATION RATE. HIGHER VALUE AT STEPS IS THE PROPER SUPERELEVATION FOR INDICATED CURVE RADIUS.

COMFORTABLE SPEED ON HORIZONTAL CURVES

SOURCE: CALTRANS HIGHWAY DESIGN MANUAL

FIGURE 4-G





DETAIL "A"

R (FEET)	MIN. D (FEET)
LESS THAN 300	300
300 - 500	200
500 - 1000	150
1000 OR MORE	0

NOTES

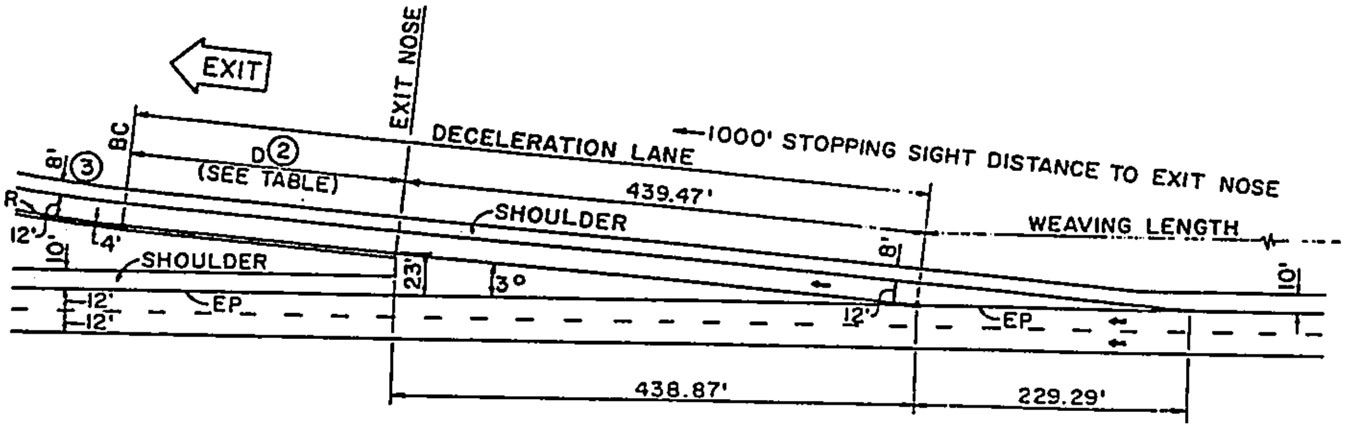
① MINIMUM LENGTH BETWEEN EXIT NOSE AND END OF RAMP IS 450' FOR FULL STOP AT END OF RAMP.

② "D" DISTANCE MAY BE ELIMINATED IN CETAIN CASES SUCH AS A RAMP FROM A COLLECTOR ROAD.

③ SINGLE LANE FREEWAY TO FREEWAY CONNECTION THE RIGHT PAVED SHOULDER SHALL BE 10 FEET.

④ WHEN FREEWAY IS NOT ON TANGENT ALIGNMENT, SELECT RADIUS TO APPROXIMATE SAME DEGREE OF CONVERGENCE.

⑤ LOCATE AS IF IT WERE TO BE CENTER OF A 1' CURB NOSE.



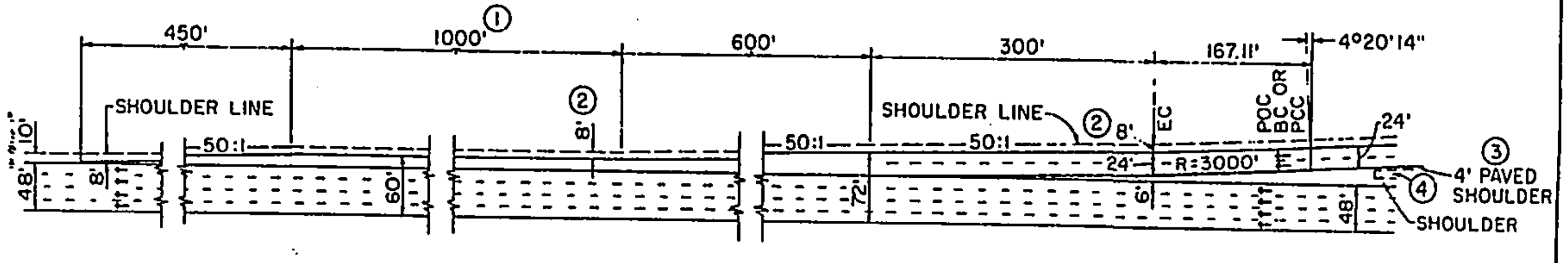
FREEWAY ENTRANCES AND EXITS

FIGURE II-D

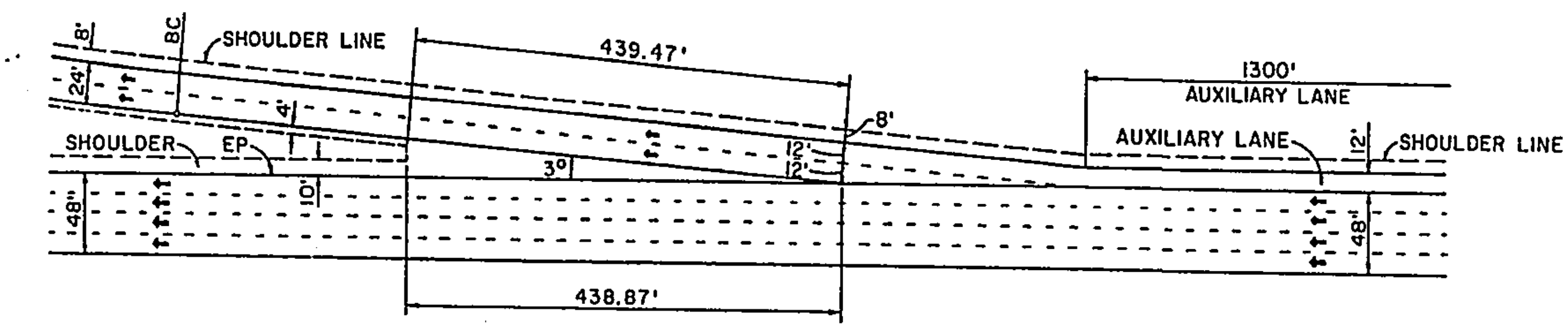
r5/15/86

NOTES:
1. 2500' FOR BRANCH CONNECTIONS
2. 10' FOR BRANCH CONNECTIONS
3. 5' FOR BRANCH CONNECTIONS
4. B-4 CURB OPTIONAL

R = 3000'
Δ = 3°11'29"
L = 167.10'
T = 83.57'



TWO-LANE ENTRANCE FOR RAMPS OR BRANCH CONNECTIONS



STANDARD 2-LANE RAMP EXIT CONNECTION (CASE I SHOWN)

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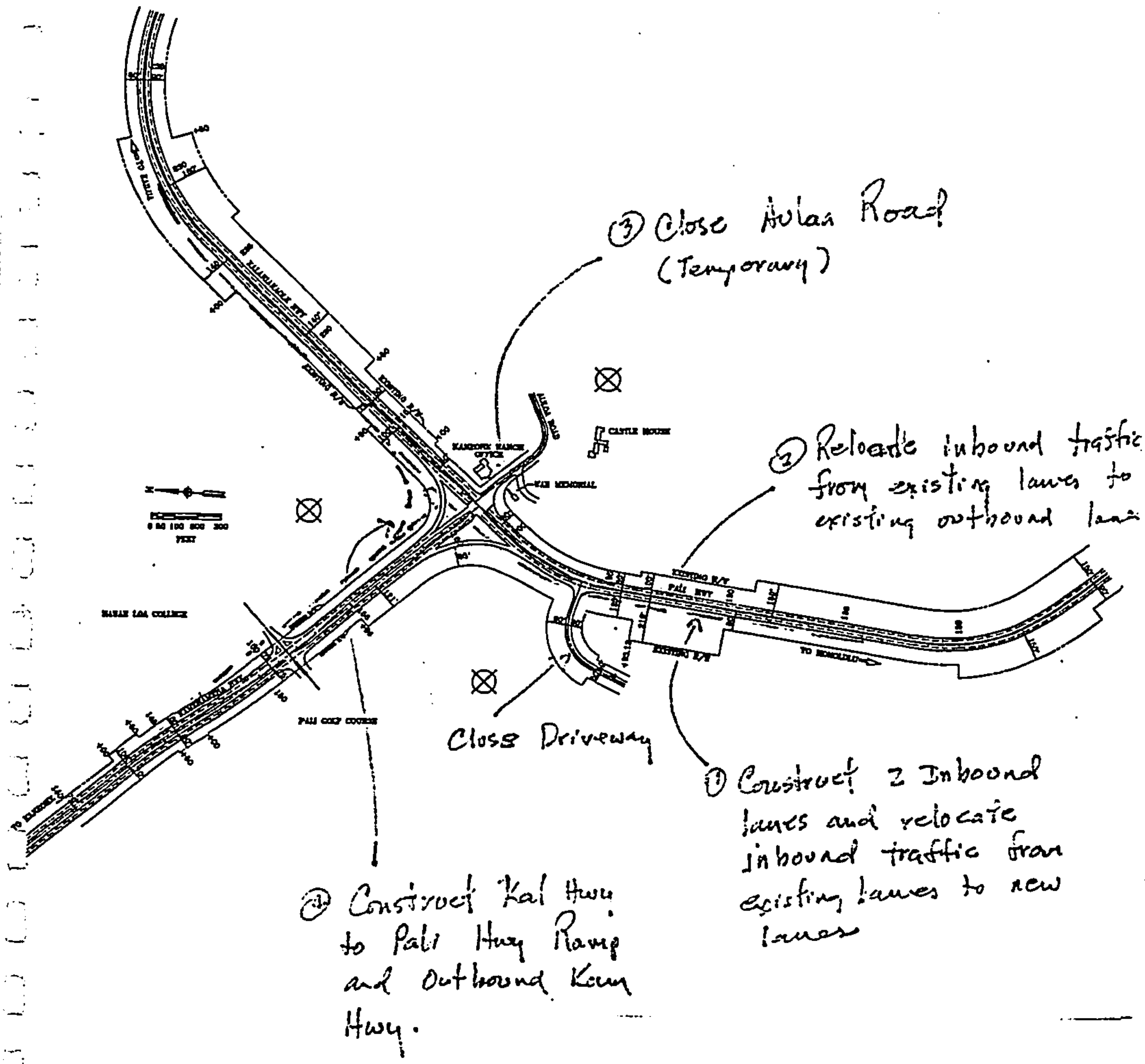
CONNECTIONS USING STANDARD ENTRANCE AND EXIT

FIGURE 11-F

APPENDIX E

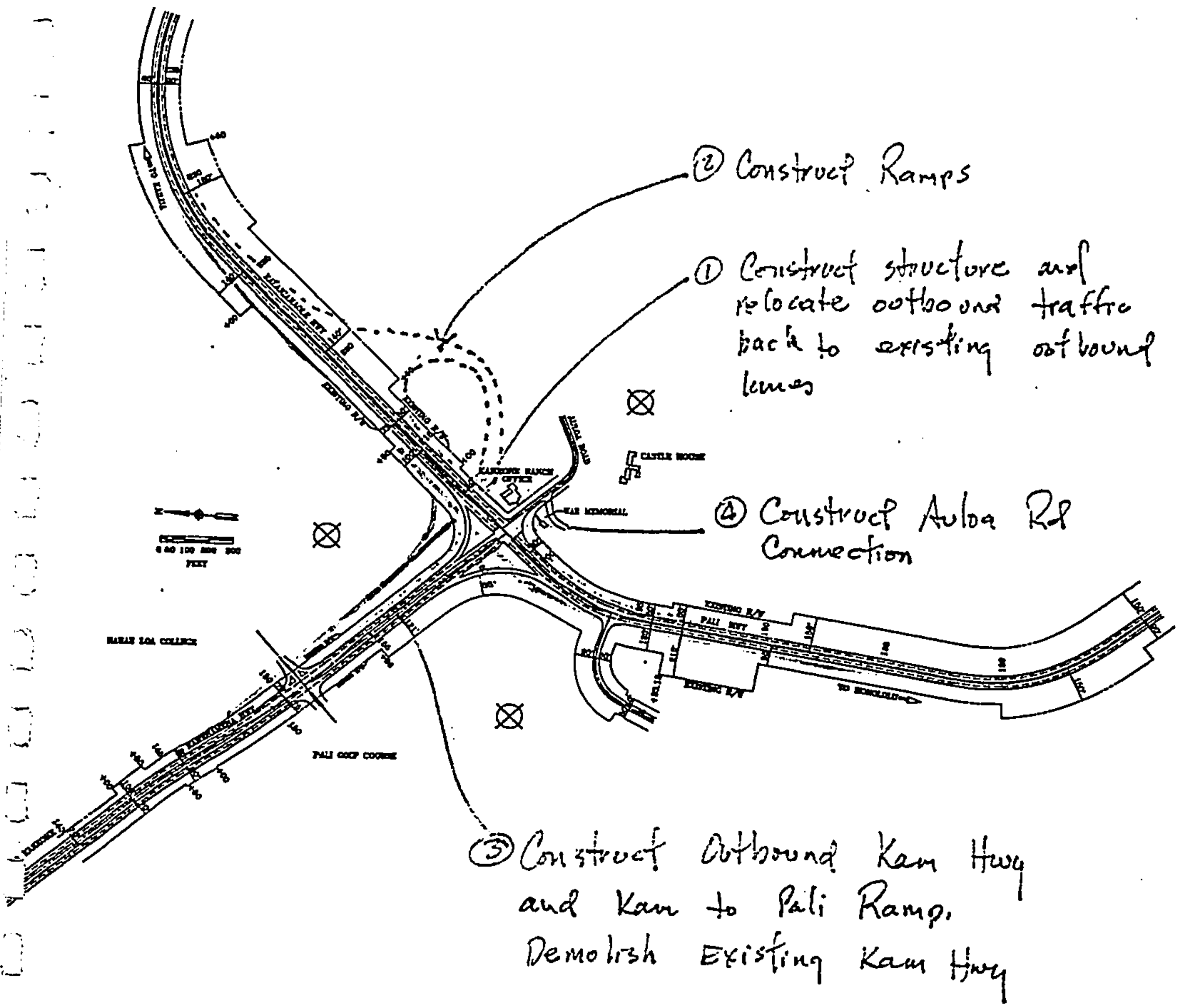
SCHEMATICS OF CONSTRUCTION PHASING
FOR ALTERNATIVES A AND C
(ALTERNATIVES B AND C ARE COMPARABLE)



PHASING PLAN

ALTERNATE A

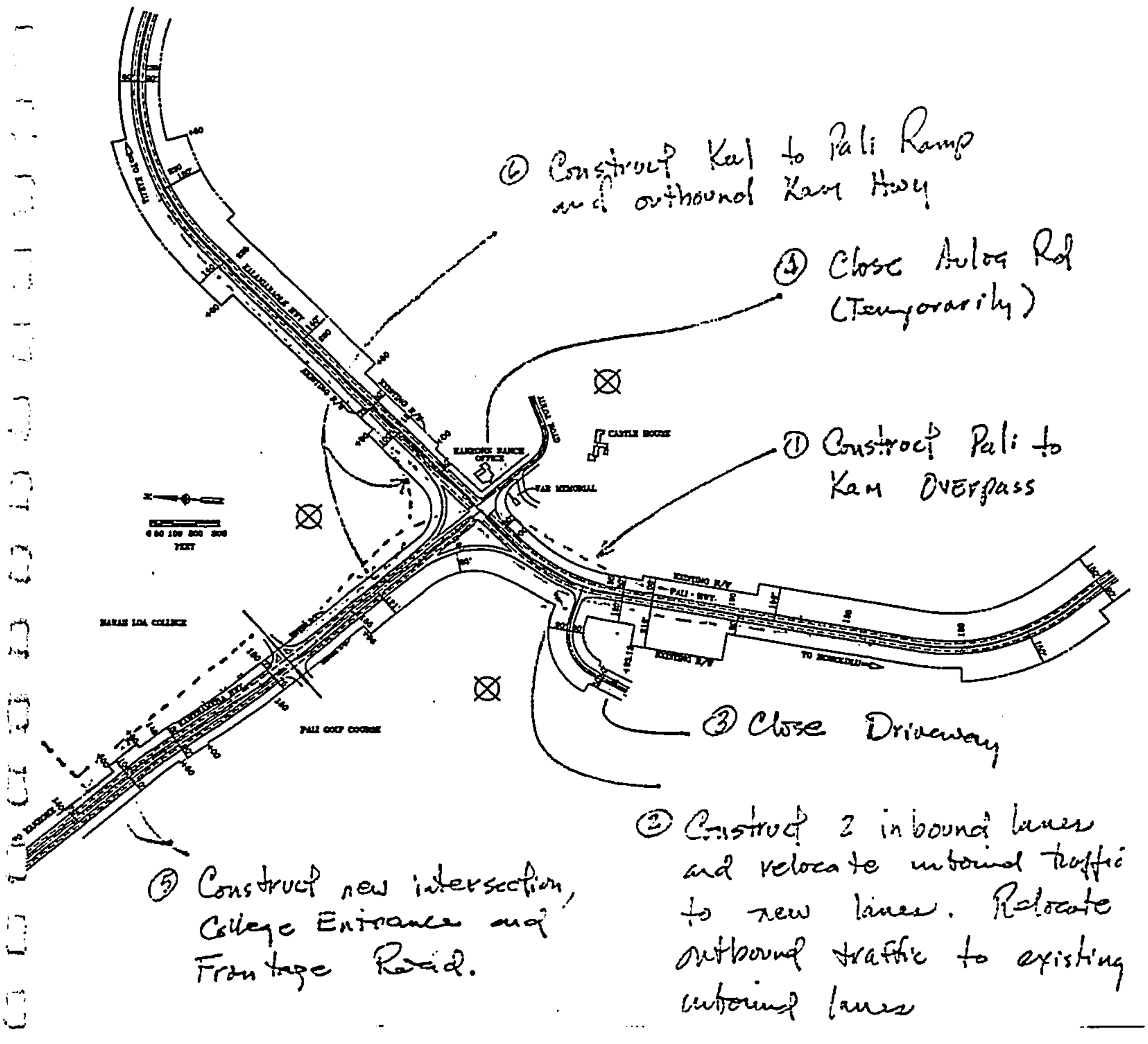
PHASE 1



PHASING PLAN

ALTERNATIVE A

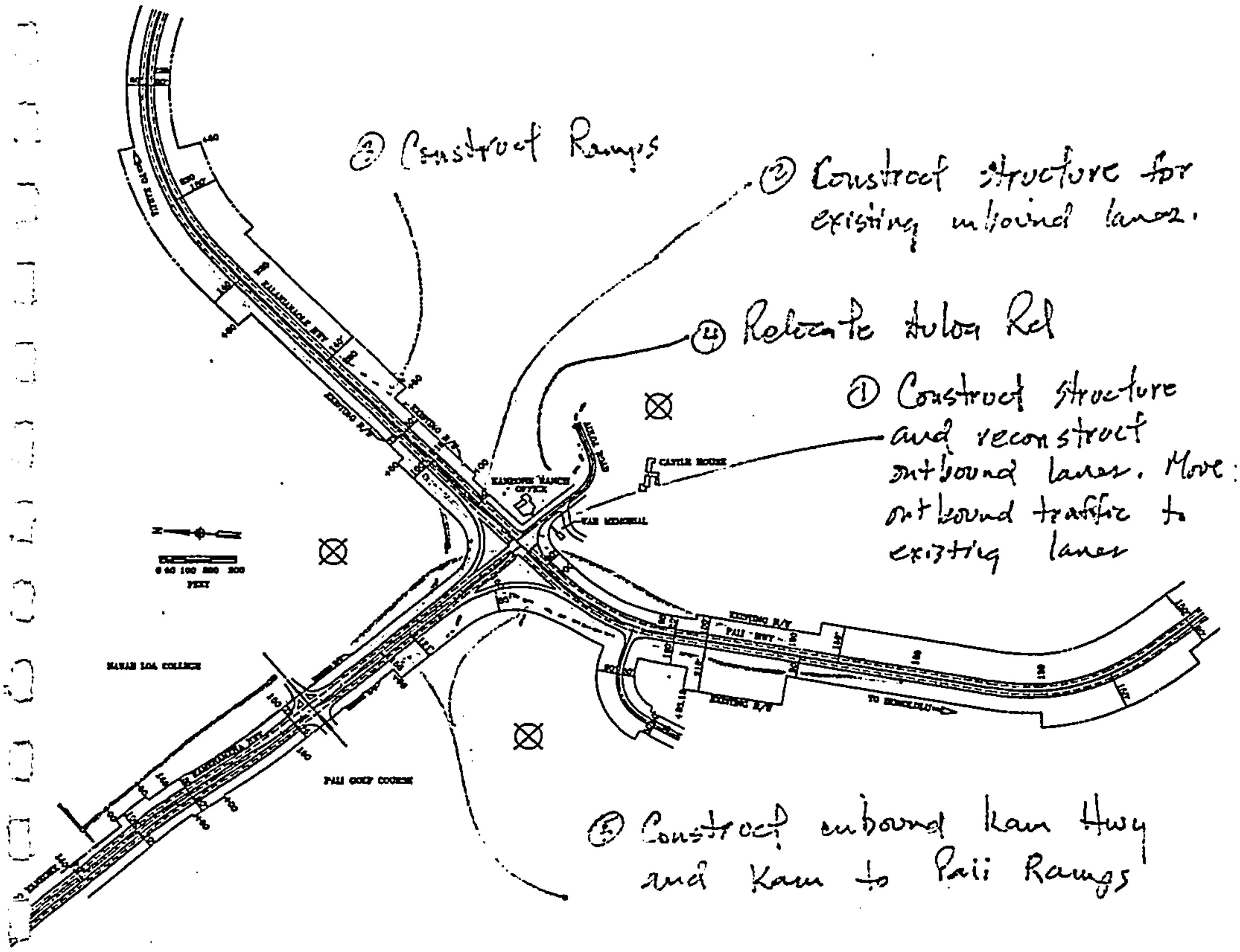
PHASE 2



PHASING PLAN

ALTERNATE C

PHASE 1



PHASING PLAN

ALTERNATE C

PHASE 2

Appendix B

NOISE IMPACT ANALYSIS

CASTLE JUNCTION INTERCHANGE

NOISE IMPACT ASSESSMENT REPORT

Prepared For

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Kawaiaho Plaza
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March 1990

ES Job No PS175

Prepared By

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1.0 INTRODUCTION

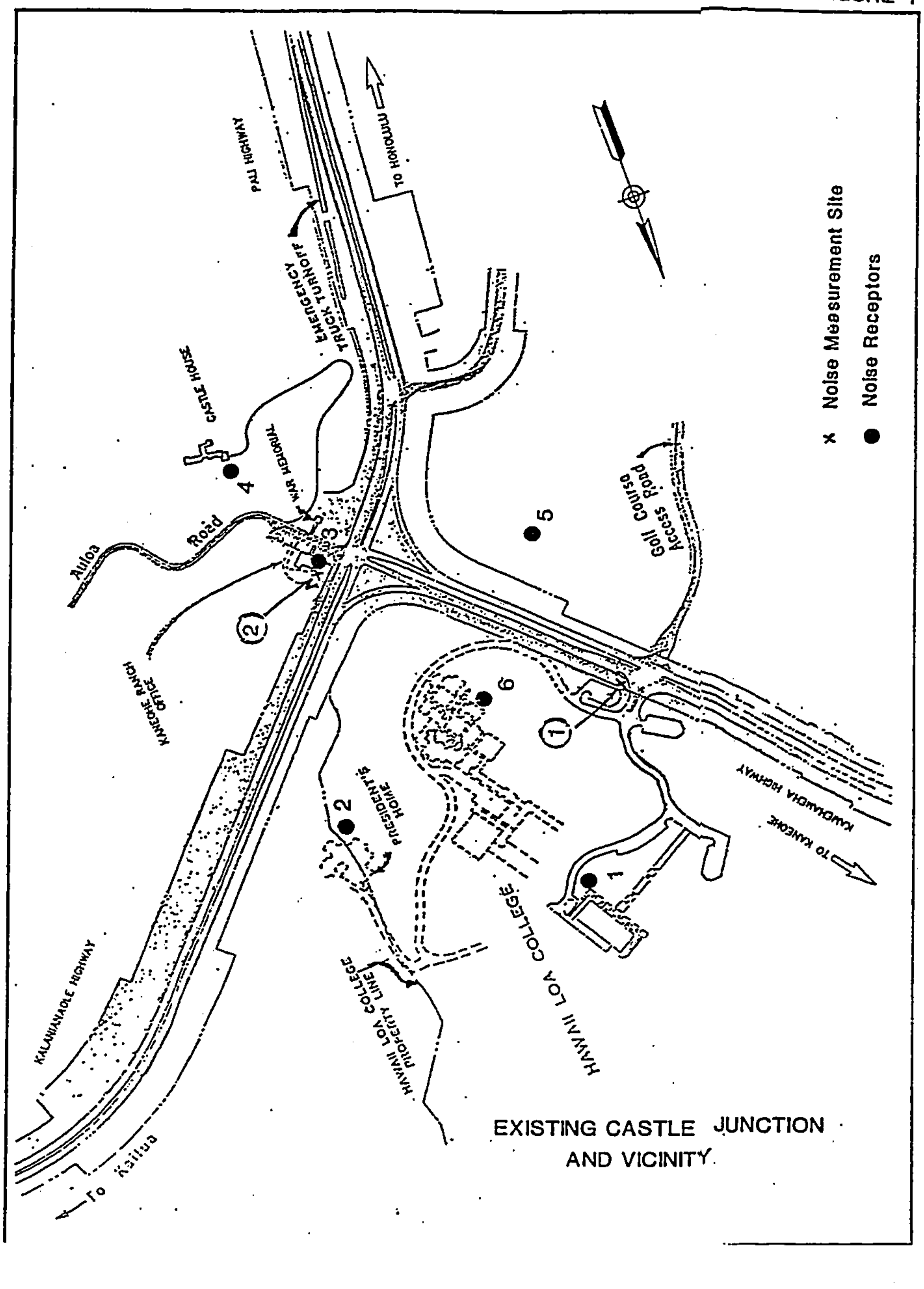
A highway interchange is proposed to replace the existing at grade intersection at the Castle Junction interchange. All of the proposed alternatives would provide grade separations to eliminate the present traffic congestions. The existing at-grade intersection lacks the inherent traffic capacity to handle the peak hour traffic. Figure 1 shows existing Castle Junction and vicinity. Figures 2, 3, and 4 show three alternatives.

The existing intersection is in a mountainous area. There is a bluff alongside Hawaii Loa College and also along both sides of Pali Highway as it approaches the junction. Deep gullies exist behind the Kaneohe Ranch and diagonally across the junction within the easterly border of the Pali Golf Course. Hawaii Loa College is located on the northerly side of Castle Junction. The Pali Golf Course is located in the southwest quadrant. Kaneohe Ranch Office, which is a historic house, is located in the southeast quadrant.

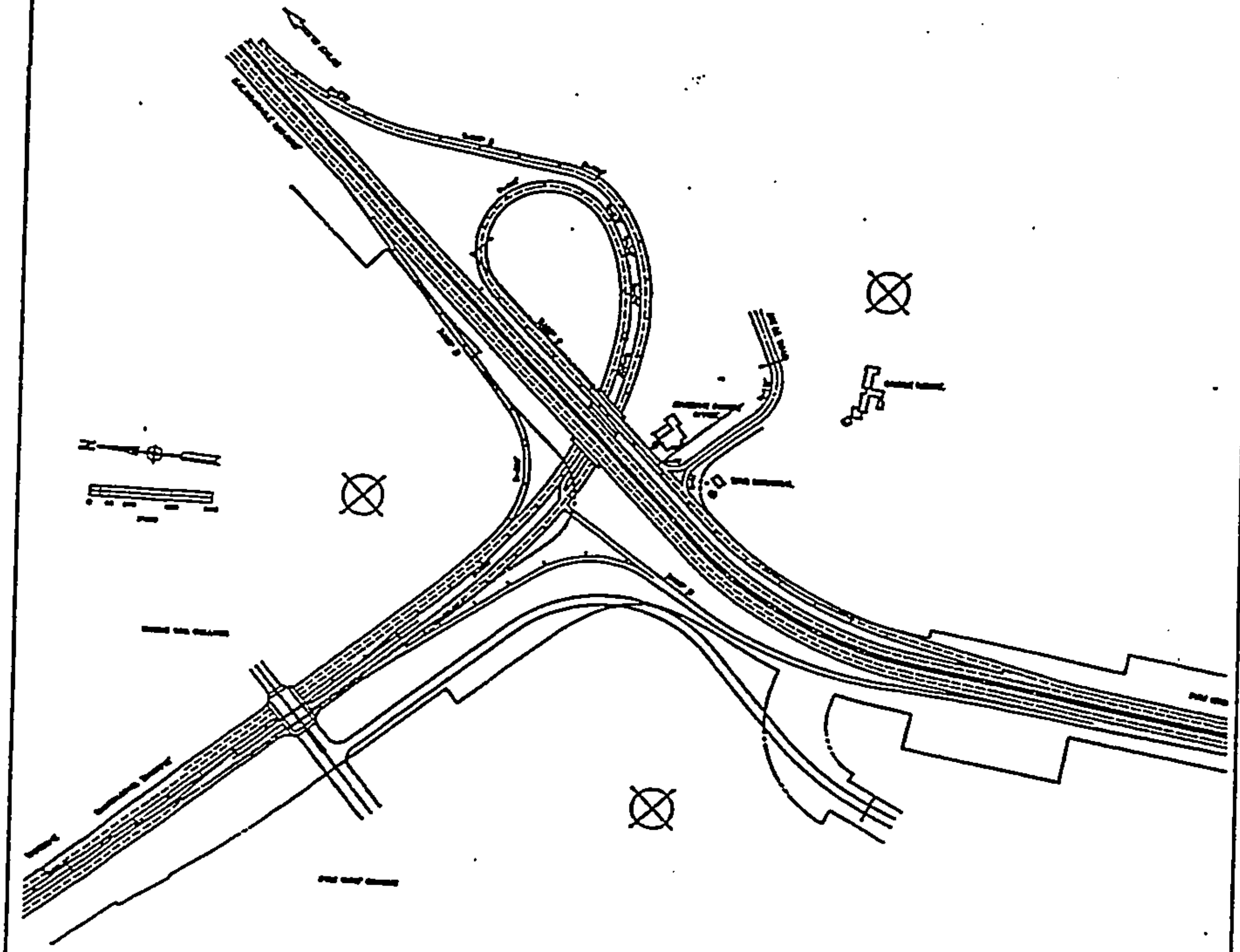
The purpose of this report is to assess the impact of existing traffic noise and the future noise impacts, for the no-build case and three proposed alternatives to improve the junction and to make recommendations to mitigate noise impacts where necessary. Alternative C was analyzed in detail because this alternative will have the worst noise impact.

Section 2 of this report presents the basis of highway noise, noise impact criteria, existing noise levels, as well as information on the computer model and traffic data used in the analyses. Noise impacts, and mitigation recommendations are discussed in Section 3. Support materials, including the glossary and references, are presented in Section 4.

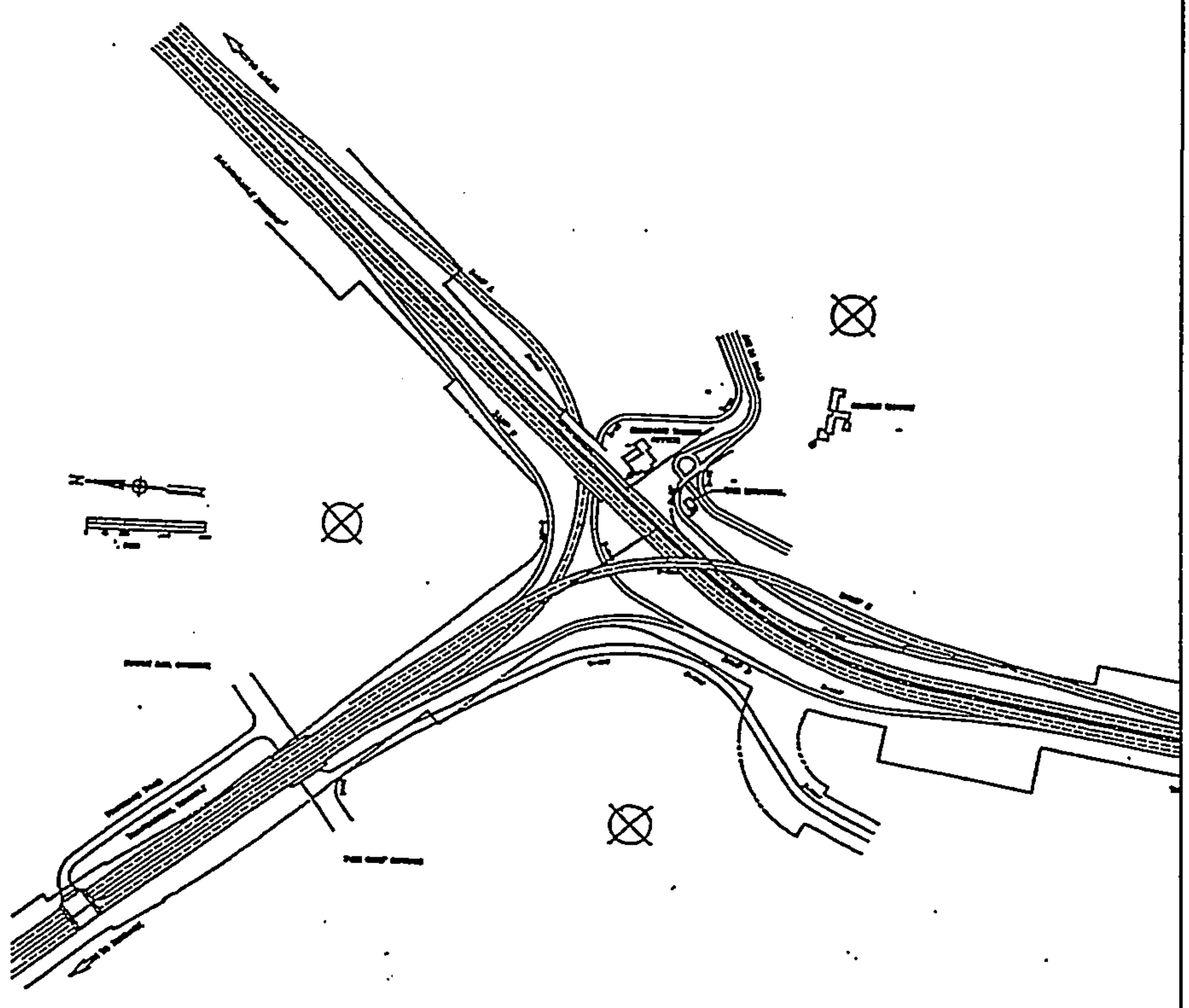
FIGURE 1



TO HONOLULU
PALI HIGHWAY
EMERGENCY TRUCK TURNOFF
CASTLE HOUSE
WAR MEMORIAL
Auloa Road
KANEOHE RANCH OFFICE
KALANIANAOLE HIGHWAY
To Kailua
PRESIDENT'S HOME
HAWAII LOA COLLEGE PROPERTY LINE
HAWAII LOA COLLEGE
Golf Course Access Road
KAMEHAMEHA HIGHWAY
TO KANEOHE
x Noise Measurement Site
● Noise Receptors
1
2
3
4
5
6
EXISTING CASTLE JUNCTION AND VICINITY

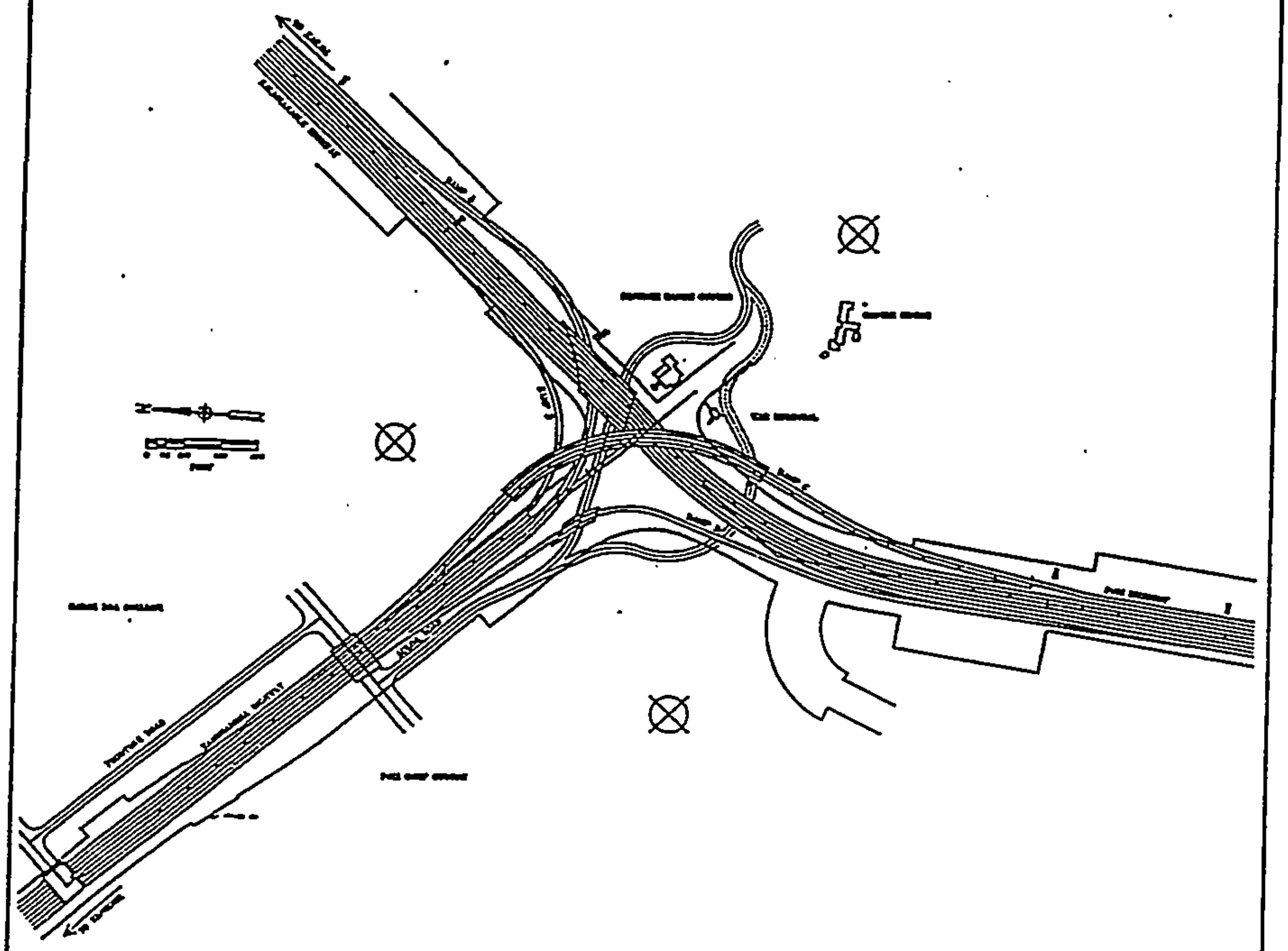


ALTERNATIVE A



ALTERNATIVE B

FIGURE 4



ALTERNATIVE C

ENGINEERING-SCIENCE

2.0 NOISE ANALYSES

2.1 Basics of Highway Noise

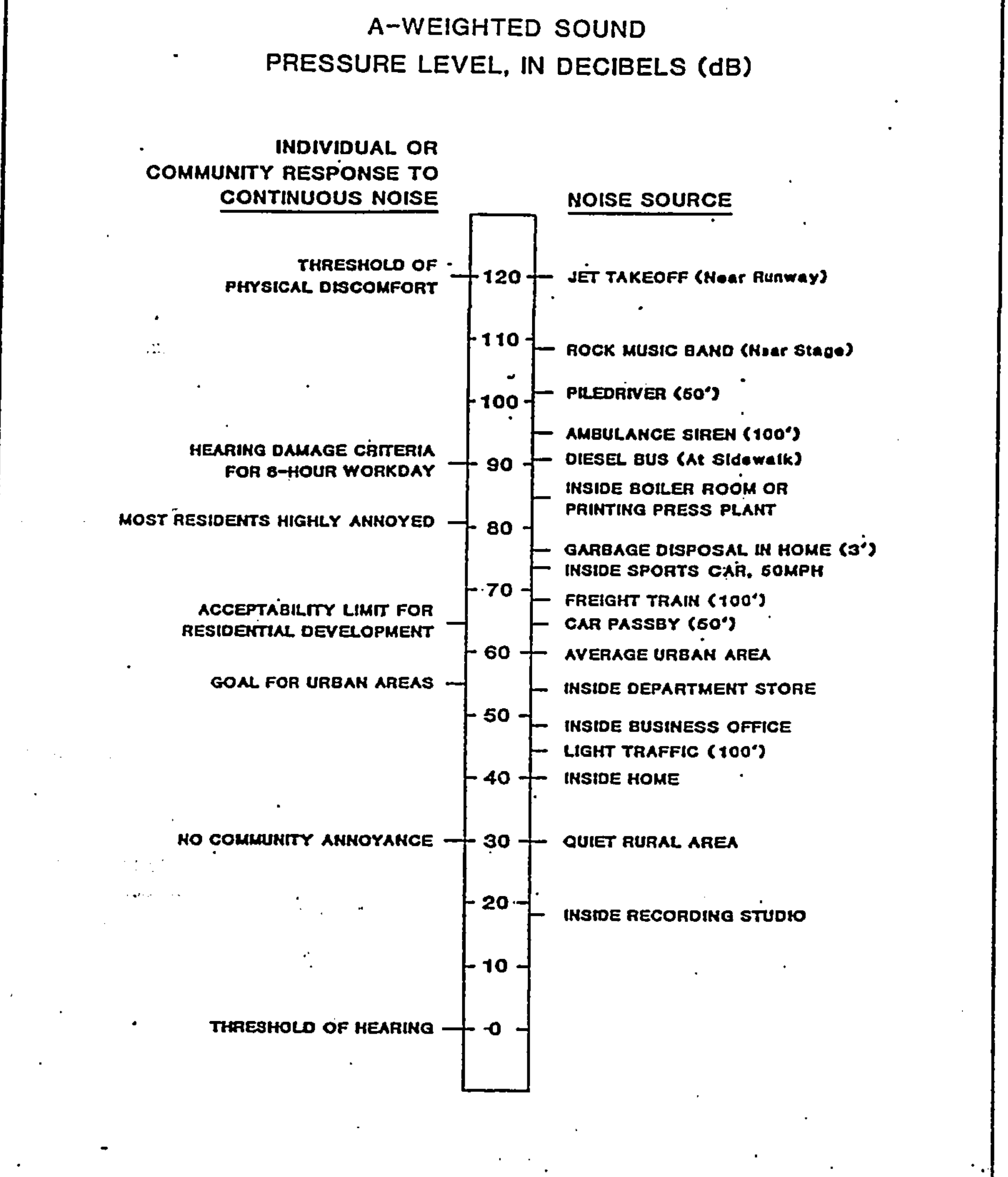
Noise is often defined as unwanted sound; it is perceived subjectively by each individual. Acceptance of a certain type of noise or noise level varies among neighborhoods, individuals, and time of day. Physically, sound pressure magnitude is measured and quantified in terms of a logarithmic scale in units of decibels, abbreviated dB. Decibels are based on the logarithm of the ratio of sound pressure over a reference pressure. Sound pressures described in decibels are called sound pressure levels. Research on human sensitivity to noise has shown that a 3 dB increase in the sound level is barely noticeable and a 10 dB increase would be perceived as twice as loud.

Sound heard in the environment usually consists of a range of frequencies or pitches at different levels. Human hearing is not equally sensitive to sound in all frequencies. A frequency-dependent adjustment called A-weighting has been devised so that sound may be measured in a manner similar to the way the human hearing system responds. An A-weighting network can be applied during noise measurements and provides a generally accepted descriptor for traffic noise. The A-weighted sound level unit is often abbreviated "dBA".

The A-weighted sound level is adequate for describing the noise at a particular instant in time. However, the average level of environmental noise fluctuates with time. The A-weighted level of background noise changes slowly with the daily cycle of human activities. The sound level descriptor used in this report is the hourly energy equivalent sound level (Leq) which considers the combined effects of all noises near and far and includes background noise and noise fluctuations. Leq is defined as the continuous A-weighted sound level that in a specified period of time contains the same sound energy as the actual time-varying sound during that period. It is a particularly stable and predictable unit for the description of traffic noise and, at the same time, is well-correlated to people's reaction to noise.

Figure 5 shows typical sound levels encountered in selected indoor and outdoor environments and typical responses of people to various levels of noise.

FIGURE 5



TYPICAL SOUND LEVELS FROM INDOOR AND OUTDOOR NOISE SOURCES AND THEIR EFFECT ON PEOPLE

2.2 Criteria for Determining Noise Impact

The criteria for noise impact at the Castle Junction are in agreement with the Noise Abatement Criteria (NAC) established by the FHWA in the Federal-Aid Highway Program Manual Volume 7, Chapter 7, Section 3, called FHPM 7-7-3 (FHWA, 1982). The FHWA criteria are reproduced in Table 1. When traffic noise levels that approach or exceed the NAC for certain land use activities, or predicted peak hourly traffic noise levels substantially exceed the existing noise levels, consideration is required for noise abatement. It is policy of the FHWA to provide noise barriers to attenuate the increased noise levels to the largest extent feasible.

This noise study is performed according to the guidelines provided in FHPM 7-7-3. This requires determination of traffic noise levels in the design year of the highway, usually 20 years in the future (year 2010 was used for this project) under conditions which will yield the worst hourly traffic noise impact on a regular basis. It is important to distinguish between worst traffic conditions and worst noise conditions. Worst traffic may be related to the capacity of the facility with congested and slow moving conditions. This is not the worst traffic noise condition. Rather, the highest traffic noise occurs when the traffic is very heavy but remains freely flowing. Traffic engineers refer to this condition as Level of Service C. More vehicles than this will cause the traffic to slow down, approaching congested conditions and resulting in lower noise levels.

According to the State of Hawaii regulations (Hawaii, 1981) no highway or freeway which can be expected to create at designed capacity operation, a noise level of 50 dBA or more inside any school classroom, library, multi-purpose room, hospital, or rest home already in existence and used for its primary design purpose, shall be constructed without first providing for noise control measures which can be expected to limit the noise level inside the facility to no more than 50 dBA.

2.3 Existing Noise Levels

A site visit was conducted during June 1989 by Engineering-Science personnel to identify representative sensitive receptor locations and to conduct background noise measurements. Noise measurements were conducted at two locations during AM and PM peak traffic noise hours. Measured Leq levels north of Kamehameha Highway near Hawaii Loa College entrance were 67 and 68 dBA during AM and PM peak traffic noise hours, respectively. Measured Leq levels near the Kaneohe Ranch Office were 73 and 74 dBA

TABLE 1

CRITERIA FOR NOISE ABATEMENT

Activity Category	Noise Abatement Criteria (dBA) Leq	Description of Activity Category
A	57 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to serve its intended purpose.
B	67 (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 (Exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	--	Undeveloped lands
E	52 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

Source: U.S. Department of Transportation, Federal Highway Administration Federal Aid Program Manual, Volume 7, Chapter 7, Section 3, Procedures for Abatement of Highway Traffic Noise and Construction Noise, Washington D.C., May 14, 1976 (Revised version in Federal Register, Vol. 47, No. 131, P. 29653 Thursday, July 8, 1982) during AM and PM peak traffic noise hours, respectively. Figure 1 shows locations of the noise measurement sites.

The following instruments were used to conduct these noise measurements.

Larson-Davis 870 Sound Level Meter
Larson-Davis 900B Preamplifier
Larson-Davis 1/2 " Condenser Microphone
B & K 4220 Pistanphone Calibrator

The Larson-Davis 870 Sound Level Meter is an ANSI Type 1 instrument. All instruments were calibrated and operated according to the manufacturers specifications.

2.4 STAMINA 2.0 Model

The FHWA preferred highway noise prediction computer model, STAMINA 2.0, was used for the noise computations (FHWA, 1982). STAMINA input requirements and basic computational procedures are outlined in this section.

STAMINA input is based on a three dimensional grid created for the study area to be modeled. All roadway, barrier and receiver points are defined by their x, y and z coordinates. Roadways and barriers are coded into STAMINA as line segments defined by their end points. Receivers, defined as single points, are typically located at sensitive receptors such as residences, schools, and churches. Receivers are modeled at a height of 5 feet above ground elevation.

In order to determine the source strength of each roadway section, the program requires traffic volumes, speeds, and grade adjustments. STAMINA contains three standard vehicle types: cars, medium trucks and heavy trucks.

The propagation path between source and receiver is modelled in STAMINA through the use of shielding factors and propagation constants. These may be coded separately for every roadway and receiver pair. Shielding factors are useful for modelling the shielding effect of rows of houses or building structures, special terrain features, and even barriers. Propagation constants are used to model the varying propagation rates between source and receiver. Generally, two basic propagation rates are used in STAMINA: hard ground propagation, which produces a 3 dB drop off per doubling of distance, and soft ground propagation producing a 4.5 dB drop off per doubling of distance. Hard ground propagation is used when either the source or the receiver is elevated or when the propagation path is over a hard surface such as asphalt. Soft ground propagation is used to model the greater propagation loss over grass or soft earth. In this noise study, soft ground propagation is used for all road and receiver pairs.

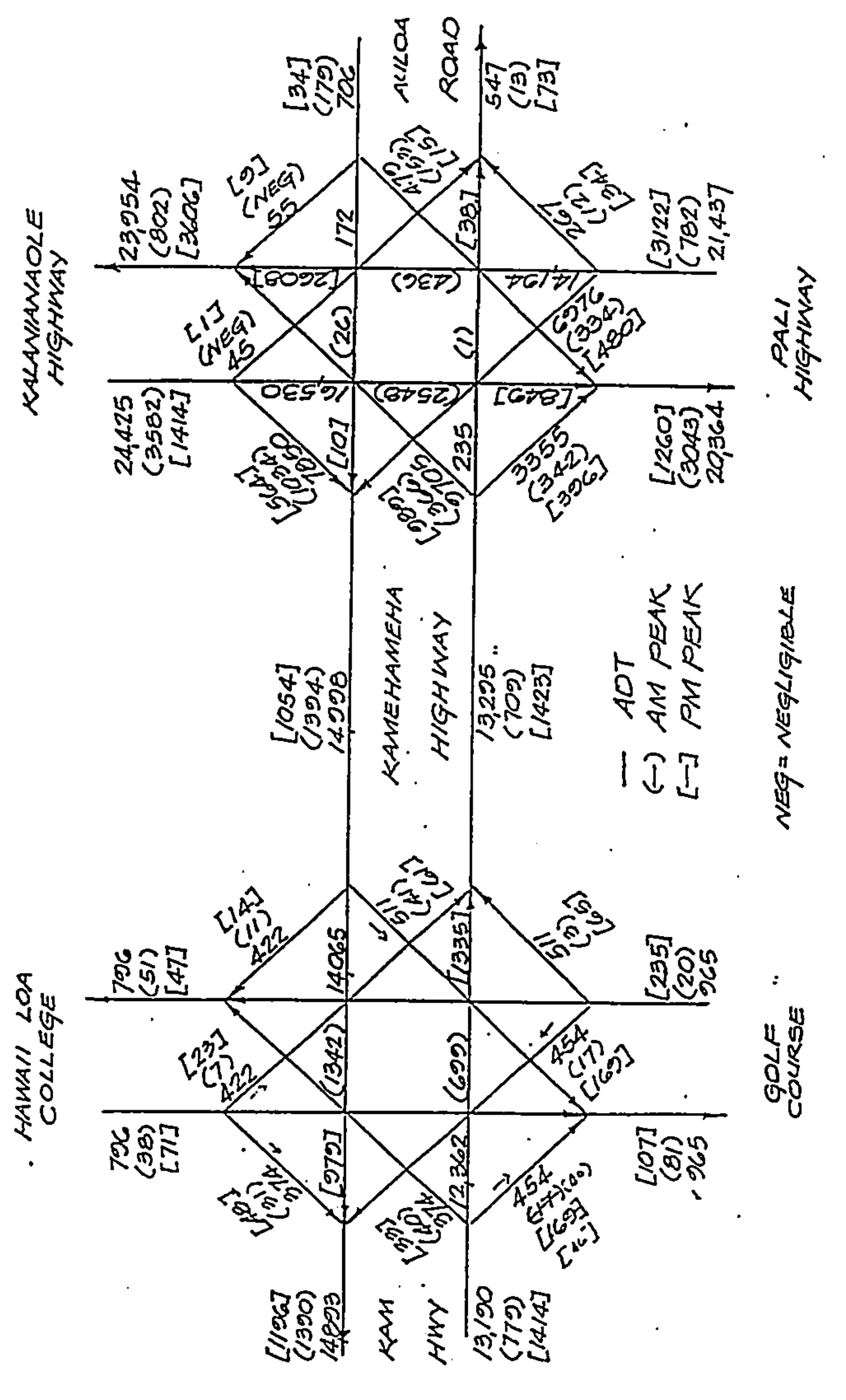
2.5 Traffic Data

Figure 6 presents the projected year 2010 average daily traffic (ADT) and peak hour traffic volumes used for the noise analysis. (Traffic, 1989). Figures 7 and 8 show AM and PM traffic volumes for the Alternative C prepared by Barton-Aschman Associates, Inc. Only this alternative was analyzed because it will have the highest noise impacts. Table 2 lists the truck factors that are used for this study. It was assumed that there will be no trucks on Auloa Road, and the Golf Course access and College access roads. For noise modeling purposes, vehicle speeds of 50 mph were used on Kalanaianaole, Pali and Kamehameha highways, 35 mph on ramps and Auloa Road, 30 mph on Golf Course access and College access roads.

TABLE 2
PERCENT BREAKDOWN OF VEHICLES

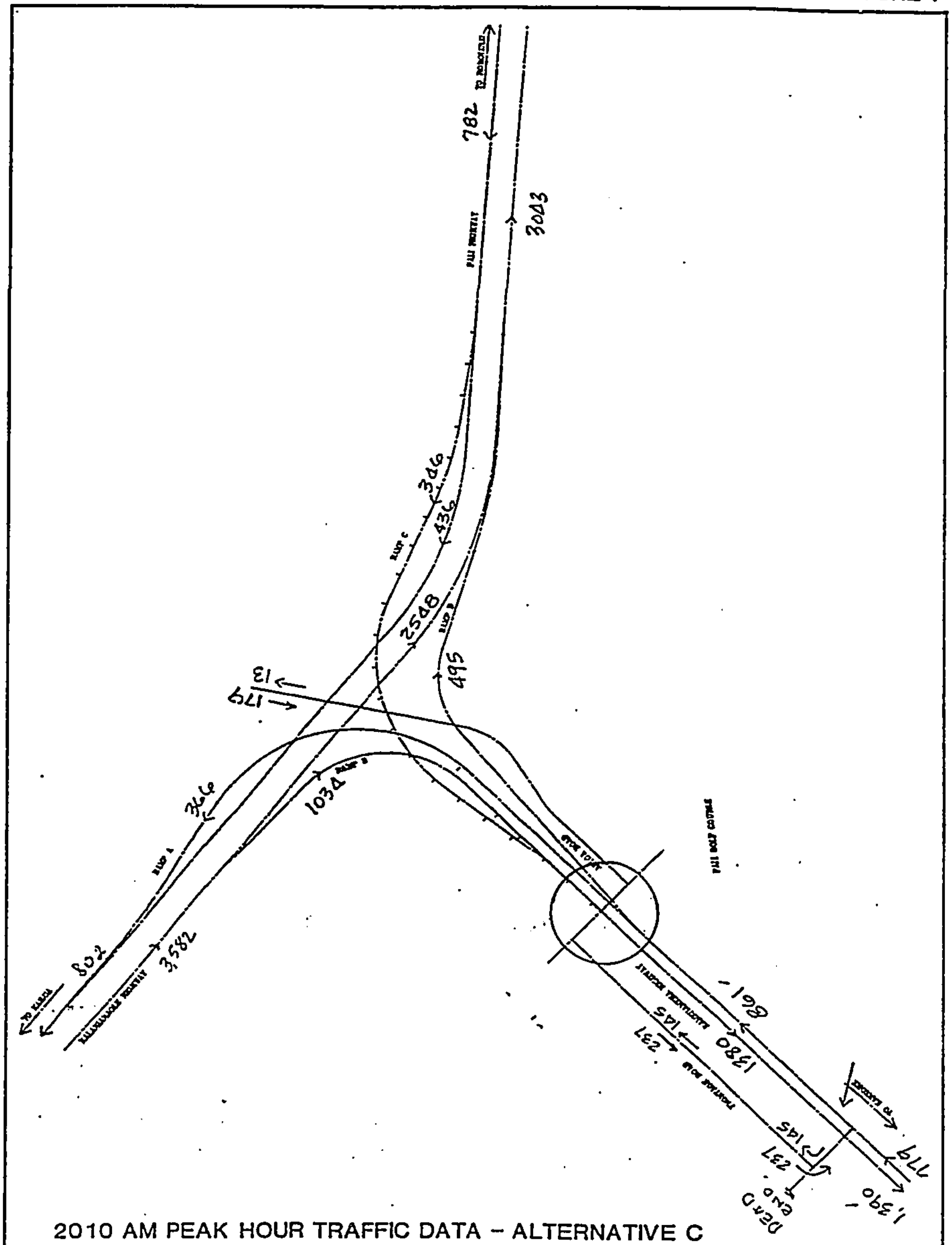
	Kalanianaole & Pali Highways		Kamehameha Highway	
Vehicle Type	AM Peak	PM Peak	AM Peak	PM Peak
Automobile	98.3	98.9	97.1	98.7
Medium Truck	0.4	0.3	2.0	0.4
Heavy Truck	1.3	0.8	0.9	0.9

FIGURE 6



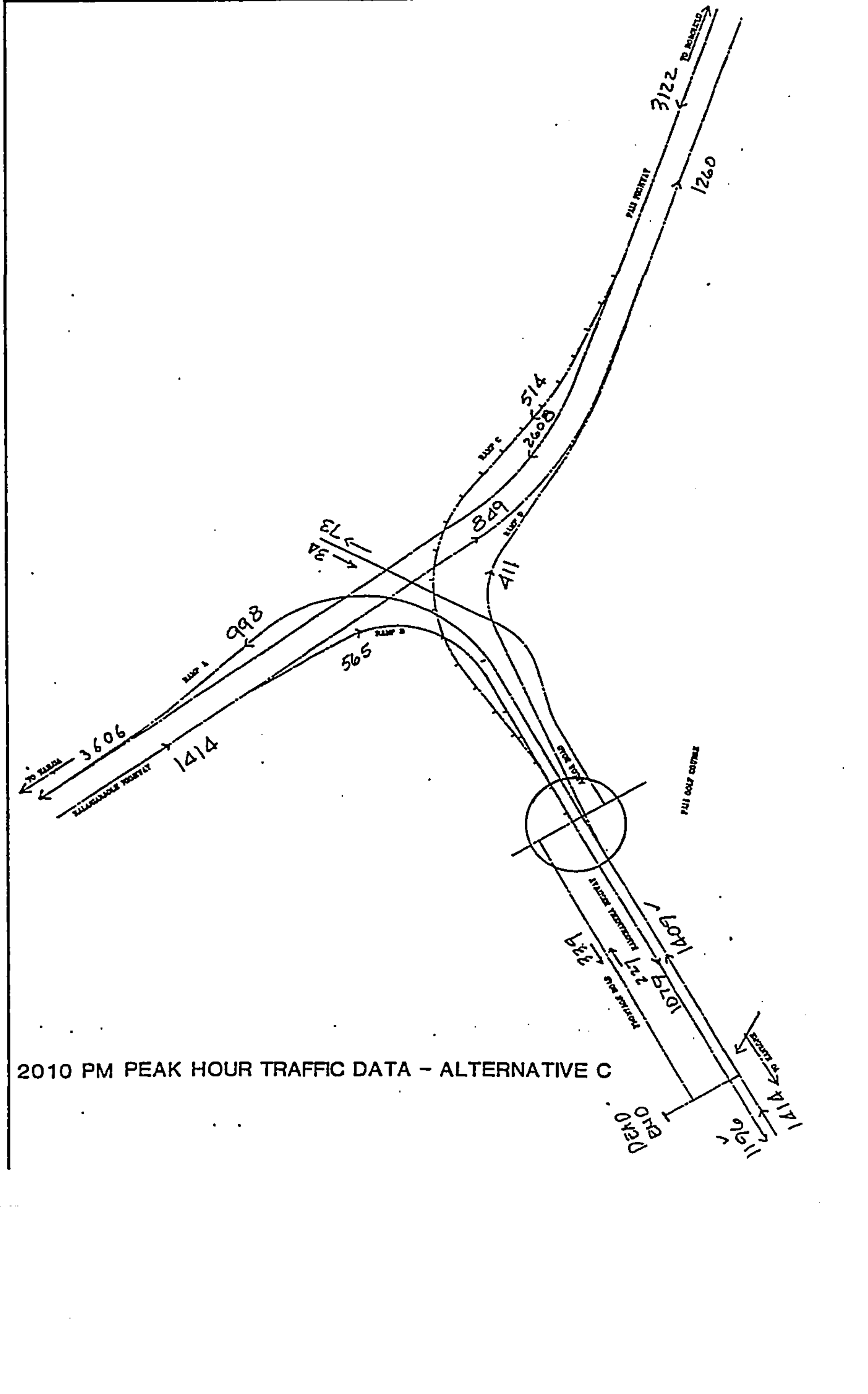
2010 TRAFFIC DATA – NO BUILD CASE

FIGURE 7



2010 AM PEAK HOUR TRAFFIC DATA – ALTERNATIVE C

FIGURE 8



2010 PM PEAK HOUR TRAFFIC DATA - ALTERNATIVE C

3.0 NOISE IMPACTS AND MITIGATION RECOMMENDATIONS

3.1 Noise Impacts

Noise impacts from the no build and Alternative C cases were evaluated at six sensitive receptor locations. . Figure 1 shows the locations of each receptor. Ramp C for this alternative will create the highest noise impact at the college and Castle House. The alignment of Auloa Road for this alternative will have a higher noise impact at the Kaneohe Ranch than the alignment of the other two alternatives. The noise levels at the golf course will be almost the same for Alternatives B and C and less for Alternative A. The noise levels at the college president's house are expected to be approximately the same for all three alternatives. Noise levels were calculated for both AM and PM peak hour traffic volumes. The highest levels obtained from the traffic noise prediction model analyses for the design year (2010) are presented in Table 3. Predicted noise levels vary between 55 and 72 dBA for the no-build case and between 55 and 70 dBA for the Alternative C.

Noise impacts from construction activity of the project are a function of the noise generated by construction equipment, their usage factors and the location and sensitivity of the nearby land areas. Normally, construction activities are carried out in stages and each stage has its own mix of equipment and noise characteristics. The maximum construction noise is expected to be generated during earth moving stage. Construction activities should have a short-term noise impact on sensitive receptors in the immediate vicinity of the construction site. The extent of the construction noise impacts on noise sensitive areas shall be calculated when the construction schedule, equipment mix and usage factors are available.

3.2 Mitigation Measures

The results of noise analyses indicate that noise mitigation measures are not required for Hawaii Loa College buildings, college president's home, Castle House, and golf course (Receptors 1, 2, 4, 5 and 6). The predicted noise levels at the exterior of the college buildings will not exceed 60 dBA. Since ordinary building construction, with the windows open, provides a noise reduction of about 10-12 dBA, the projected interior noise levels will meet the State of Hawaii and FHWA criteria.

Noise levels will be 72 dBA at the Kaneohe Ranch Office (Receptor 3) for the no-build case, but it will be reduced to 70 dBA for Alternative C. Because this historic building is used as an office, no noise mitigation is required.

A permit shall be required for the construction activities. According to the State of Hawaii regulations (Hawaii, 1981) no construction activities shall be permitted before 7:00 a.m. and after 6:00 p.m. when construction activities create excessive noise at the sensitive receptor locations. Construction activities that create noise levels of more than 95 dBA at or beyond the project property line are not allowed before 9:00 a.m. and after 5:30 p.m. during weekdays and are not allowed on Saturdays, Sundays and on the following holidays; New Year's Day, President's Day, Memorial Day, Kamehameha Day, Independence Day, Labor Day, Discovers Day, Veteran's Day, Thanksgiving Day, and Christmas Day. It may be necessary to conduct some construction activities at evening hours to avoid construction noise impacts on the classrooms.

Visual monitoring and inspection of construction equipment shall be conducted at periodic intervals to insure that the equipment is properly maintained and equipped with the manufacturer's noise abatement devices, such as mufflers and engine covers.

TABLE 3
CASTLE JUNCTION TRAFFIC NOISE PREDICTION

RECEPTOR NO.	LAND USE	NOISE CRITERIA dBA	EXISTING NOISE LEVELS dBA	DESIGN YEAR (2010) PEAK HOUR NOISE LEVELS, Leq(h), dBA	
				NO BUILD	ALTERNATIVE C
1	COLLEGE	67	68 (M)(1)	55	55
2	COLLEGE PRESIDENT'S HOME	67	59 (E)	57	56
3	KANEOHE RANCH OFFICE	72	74 (M)	72	70
4	CASTLE HOUSE	67	58 (E)	60	59
5	GOLF COURSE	67	64 (E)	62	60
6	COLLEGE	67	60 (E)	61	60

NOTES:
(M) Measured noise level.
(E) Estimated based on measurements at a similar location.
(1) Measurement location is closer to the road than the prediction location.

4.0 SUPPORT MATERIAL

A glossary of terms used in this report and a list of references are presented in this section.

4.1 Glossary

A-weighted Sound Level: The most generally used measure of the magnitude of traffic noise. It is defined as the sound level, in decibels, measured with a sound-level meter having the metering characteristics and a frequency weighting specified in American National Standard Specifications for Sound Level Meters, ANSI S1.4-1971. It is common practice to refer to the numerical units of an A-weighted sound level as "dBA". The A-weighting tends to de-emphasize lower-frequency sounds (e.g. below 1,000 Hz).

Ambient Noise Level: The noise level existing in an area before introduction of the proposed roadway. This quantity is measured in dBA and expressed as Leq ambient noise levels.

At-Grade Roadway: A roadway element that is level with the immediate surrounding terrain.

Automobiles: All vehicles with two axles and four wheels designed primarily for passenger transportation or cargo (light trucks). Generally, the gross vehicle weight is less than 4,500 kilograms.

Average Daily Traffic (ADT): The number of vehicles that pass over a given roadway during a one day period. The average daily traffic is calculated by determining the total number of vehicles during a given period in whole days and dividing by the number of days in the period.

Average Highway Speed (AHS): The weighted average of the design speeds within a roadway section.

Barrier: A solid wall or earth berm located between the roadway and receiver location, which breaks the line-of-sight between the receiver and the roadway sources.

Depressed Roadway: A roadway that is constructed below the immediate surrounding terrain.

Decibel (dB): A logarithmic "unit" that indicates the ratio between two powers. A ratio of 10 in power corresponds to a differences of 10 decibels.

Design Noise Level: Noise levels for various activities or land uses which represent the upper limit of acceptable traffic noise conditions. These levels are used to determine the degree of impact of traffic noise on human activities.

Design Year: The future year used to estimate the probable traffic volume for which a highway is designed. A period of 10 to 20 years from the start of construction is usually used.

Elevated Roadway: A roadway that is constructed above the immediate surrounding terrain, either on a land fill or a structure.

Existing Noise Levels: The noise resulting from the natural and mechanical sources and human activity usually present in a particular area.

Heavy Trucks: All vehicles having three or more axles and designed for the transportation of cargo. Generally, the gross weight is greater than 12,000 kilograms.

Leq: The equivalent steady-state A-weighted sound level which, in a stated period of time, would contain the same acoustical energy as the time-varying sound during the same period.

Leq(h): The Leq for one hour.

Medium Trucks: All vehicles having two axles and six wheels designed for the transportation of cargo. Generally, the gross vehicle weight is greater than 4,500 kilograms but less than 12,000 kilograms.

Noise Contour: An imaginary line shown on a plane along which sound levels of a designated value are all equal.

Noise Level Reduction: The change in noise level at an observer location due to the presence of a shielding element between the roadway and the observer.

Receivers: The location at which noise levels are computed and analyzed. Also referred to as the observer (5 feet above the ground).

Reference Energy Mean Emission Level: The level of noise emitted by vehicles traveling on the highway. The emission level is defined as the A-weighted maximum pass-by noise level generated by a vehicle at a distance of 15 meters from the centerline of the traffic lane. California vehicle noise emission levels are the basis of the analysis presented herein.

Right-of-Way: A general term denoting land, property, or interest therein, usually in a strip, acquired for or devoted to transportation services.

Roadway: Used here to designate any arterial highway, expressway, freeway, or parkway for which the analyses developed in this guide is applicable.

Shielding: Any construction or natural barrier which, when interposed between the roadway and the observer, will provide an excess reduction in roadway noise.

Sound Level (Noise Level): Weighted sound level measured with a sound-level meter having metering characteristics and a frequency weighting network (A, B, or C) as specified in the sound-level meter standard.

Speed: The rate of movement of vehicular traffic in miles per hour (mph).

Traffic Noise Impacts: Impacts which occur when predicted traffic noise levels equal or exceed the noise abatement criteria levels.

4.2 References

Federal Highway Administration (FHWA), 1982. Noise Barrier Cost Reduction Procedure. STAMINA 2.01 OPTIMA: Users Manual, FHWA-DP-58-1, April.

FHWA, 1982. Federal-Aided Program Manual, Volume 7, Right-of-Way and Environment; Chapter 7, Environment; Section 3, Procedures for Abatement of Highway Traffic Noise and Construction Noise (FHPM 7-7-3).

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Appendix C

GEOTECHNICAL SURVEY

Harding Lawson Associates

November 8, 1989

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Parsons Hawaii
P. O. Box 29909
Honolulu, Hawaii 96820

Attention: Mr. George Krasnick

Gentlemen:

Geotechnical Consultation
EIA for Proposed Castle Junction Interchange
Kaneohe, Oahu, Hawaii

This letter report presents our evaluation of the geotechnical aspects of proposed highway improvements at Castle Junction in Kaneohe. Our comments are based on a review of geologic literature, a site reconnaissance, examination of aerial photographs, and our experience with geotechnical engineering projects in Hawaii.

PROJECT DESCRIPTION

As shown on Plate 1, the present intersection consists of the meeting of four separately-named roads at an at-grade intersection controlled by traffic lights. The four-lane Pali Highway runs generally northeastward to the intersection. Beyond the intersection, the four-lane highway continues northeastward towards Kailua as Kalanianaole Highway. The four-lane Kamehameha Highway runs southeastward to the intersection and terminates. Beyond the interseciton, Auloa Road continues eastward, providing access for the Maunawili section of Kailua.

The new project would provide a grade separation at the intersection. A number of configurations are under study, but design details are not yet available because a final interchange configuration has not been selected. Construction elements affected by geotechnical considerations will include high cuts and fills, foundations for elevated structures, and retaining walls. Our comments are generic in nature, because we have not reviewed any specific interchange configuration.

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SITE DESCRIPTION

The project area is shown on Plate 1. To the west of the interchange is a gently sloped area occupied mostly by the Pali Golf Course. This sloped area terminates at Hawaii Loa College against the mass of Ulumawao Peak to the northeast. Surface drainage runs northwest through Hawaii Loa College as part of the Kamooalii Stream watershed.

The interchange sits at the head of a deep valley to the east-northeast that drains the rest of the project area into Kahanaiki Stream. The head of the valley, and the intersection, occupy a low spot or saddle in the Oneawa Ridge which runs southwest from Ulumawao Peak towards the central core of the Koolau Mountains. A lower ridge runs eastward from the intersection along the south side of Auloa Road.

Construction of the existing highways resulted in high cut and fill slopes. Dramatic benched cuts more than 50 feet high exist along the northwest side of Kalanianaole Highway, and lower cuts are on both sides of the Pali Highway, near the southern end of the project area. We observed that most of the slopes were cut steeper than 1:1 (between benches) and have eroded and sloughed extensively, depending on the degree of weathering of the slope material. No signs of massive slope failure were noted.

Fill slopes more than 50 feet high exist along the southeastern side of Kalanianaole Highway, and lower fill slopes exist along both sides of Kamehameha Highway, including the southbound feeder lane onto the Pali Highway.

We observed that most of the fill slopes were constructed at slopes of about 1.5:1 (horizontal:vertical) without benches. These slopes have eroded where exposed to road runoff or concentrated culvert flow, but no areas of slope failure were noted.

No walls or other highway structures currently exist. Most culverts that we observed are located under Kamehameha Highway to carry flow northeastward.

GEOLOGY AND SOILS

The project area is within the caldera area of the Koolau Volcano (Walker, 1987). Possibly several thousand feet of rock has been eroded away, exposing the many conduits of molten magma which once fed the volcano. These hardened into near-vertical thin tabular bodies known as dikes. An excellent exposure of this dike complex exists in the cuts along the northwest side of Kalanianaole Highway. Rocks within the caldera area are called the Kailua Member of the Koolau Basalt (Walker, 1987). Within the project area, the dikes are so close together that they comprise most of the rock mass (Stearns and Vaksvik, 1935). The exposure just northeast of the intersection was studied by Walker (1987) who found it to consist of 70 percent dike rock, and with an average of 100 dikes per 100 meters of horizontal exposure.

The smoothly sloping area to the west of the interchange is an old alluvial fan complex, originally coarse sand and gravel deposits eroded from the Pali cliffs along the northeast side of the Koolau Mountains. The deposits are sufficiently old that most of the rock fragments have been decomposed in-place to form a clayey soil still retaining the original coarse-grained texture. These deposits commonly are referred to as "older alluvium" (Stearns, 1939).

The U.S. Department of Agriculture (1972) mapped the distribution of soil types in the area. The surface geology shown on Plate 1 is generalized from their map. The area shown as Weathered Rock consists of soils of the Alaeloa and Helemano Series; the Older Alluvium is the Kaneohe Series; and the Young Alluvium is the Hanalei Series.

The Alaeloa Series consists of clayey soils developed from in-place decomposition of basaltic bedrock. The Helemano Series includes up to a few feet of transported material along steep gullies. Decomposition and weathering can extend many tens of feet, as shown in the road cuts along Kalanianaole Highway, with weathering gradually decreasing with depth, and the amount of intact rock increasing.

The Kaneohe Series consists of clayey soils derived from coarse alluvium as described previously. In some locations, the soil may have been derived from deposits of volcanic ash and cinder as well. Total thickness of these deposits can be several tens of feet. They likely rest on weathered bedrock.

The Hanalei Series consists of modern alluvial soils deposited along existing drainages. It typically consists of soft clayey soils to depths of more than 5 feet. This soil in the bottom of the valley southeast of Kalanianaole Highway is mapped as stonier than that at Hawaii Loa College.

GROUND WATER

The rocks of the Kailua Member of the Koolau Basalt usually are so dense that they are essentially impermeable. Takasaki et al. (1969) describe a well along Auloa Road east of the project area with a specific capacity of only 1.5 gallons per minute per foot of drawdown. As a result, no groundwater development exists in the project area. Southeast of the project area, ground water has been developed by tunnels into the more permeable Koolau basalts in the upper part of Maunawili Valley. There, the dikes are more widely spaced and serve to trap ground water in compartments of more permeable basalt (Stearns and Vaksvik, 1935).

Small amounts of ground water may occur in seeps through joints in the bedrock and at contacts between soil and rock or between dissimilar soils. Such seeps could be of importance to stability of cut and fill slopes. No signs of such seepage were seen during our reconnaissance. Should subsurface water be found, either during later subsurface investigations for design of the project or during construction, it should be evaluated relative to its impact on slope stability.

EXCAVATIONS

Little hard rock is likely to be encountered in excavations for new construction. Therefore, excavation by conventional heavy earth-moving equipment is believed to be feasible. The need for removal of rock by blasting or pneumatic vibratory equipment is believed to be very limited, although this should be evaluated further by subsurface investigations for final design.

CUT AND FILL SLOPES

New earthwork is likely to include high cut and fill slopes, particularly along Kalanianaole Highway where they already exist. Observation of existing slopes indicates that cuts at an inclination of 1:1 and slopes at an inclination of 1.5:1 have remained stable. Steeper cuts have eroded and sloughed significantly, but do not appear to have any deep-seated movements.

Some erosion and sloughing on 1:1 cut slopes still is likely to a lesser degree, because they will be too steep to vegetate. The use of benches on the slopes and a ditch area at the base to collect eroded material for later periodic removal will be desirable. Generally, the existing benches appear to have served that purpose.

New fill slopes at inclinations no steeper than 1.5:1 are likely to be stable, given proper embankment compaction and control of subsurface drainage. Also, preparation of an embankment area at its toe will be important to avoid soft soils and control possible seepage. The highest fills would likely be along Kalanianaole Highway. Our field reconnaissance did not reveal any areas of concern at the base of existing fills, but access was very difficult because of heavy vegetation and not all areas could be reached.

Subsurface investigations for final design should include development of data for stability analyses and design of all significant cut and fill slopes.

FOUNDATIONS

Foundations will be required for elevated structures and retaining walls. We judge that foundations on fill or deep soils of either decomposed rock or older alluvium can be designed for bearing pressures ranging between 3,000 and 6,000 pounds per square foot (psf) with acceptable settlements. Foundations on competent rock probably can be designed for bearing pressures as high as 10,000 psf.

Concentrated loads on foundations for elevated structures may result in unacceptably large footings using the above range of bearing pressures.

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In that case, deep foundations such as driven piles or cast-in-place piers may be required to transfer the loads deeper to more competent material. Such foundations are not uncommon, but subsurface investigations for all the structures, regardless of foundation type, should be done prior to final design.

OTHER CONSIDERATIONS

The exposure of the dike complex in the road cuts along Kalanianaole Highway are of geologic importance as a classic example of these features. Consideration should be given to preserving such exposures in the final cuts in this area. Further, consideration should be given for temporary parking in the vicinity and for interpretive materials to explain the exposure to anyone interested in the volcanic formation of Oahu.

We trust this information is adequate for your purposes. If you have any questions, do not hesitate to call.

Sincerely yours,

HARDING LAWSON ASSOCIATES

Damon R. Runyan
Civil Engineer - 3121

DRR/rc

Attachments: References
Plate 1 - Geologic Map

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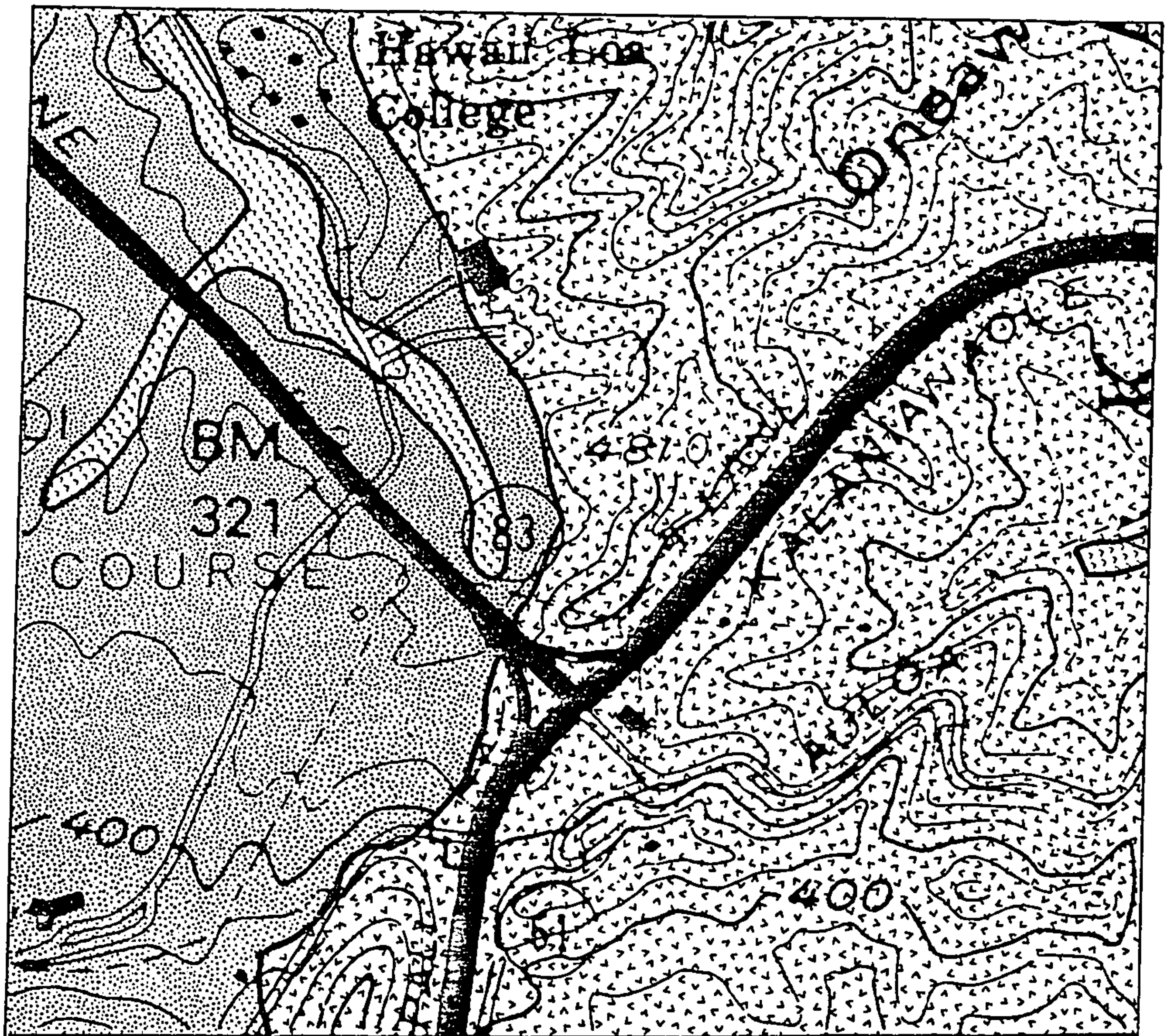

REFERENCE: 1) USGS Topographic Map, 1983, Kaneohe Quadrangle.

2) USDA Soil Survey, 1972, Map No. 60.

0 500 1000 feet

Scale

N

LEGEND:

Weathered Rock

Older Alluvium

Young Alluvium

Harding Lawson Associates
Engineering and Environmental Services

Geologic Map
Castle Junction Interchange
Kaneohe, Oahu, Hawaii

PLATE 1

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
kar	03936,053.06	DRR	11/89	

Appendix D

BOTANICAL SURVEY

BOTANICAL SURVEY
CASTLE JUNCTION INTERCHANGE PROJECT
KO'OLAU POKO DISTRICT, ISLAND OF O'AHU

by

Winona P. Char

CHAR & ASSOCIATES
Botanical/Environmental Consultants
Honolulu, Hawaii

Prepared for: PARSONS HAWAII

September 1989

Table of Contents

BOTANICAL SURVEY
CASTLE JUNCTION INTERCHANGE PROJECT
KO'OLAU POKO DISTRICT, ISLAND OF O'AHU

INTRODUCTION

A highway interchange is proposed to replace the existing at-grade intersection at Castle Junction. Castle Junction is formed by the intersection of three State highways (Pali Highway, Kalaniana'ole Highway, Kamehameha Highway) and a County road (Auloa Road). The surrounding terrain is mountainous with deep gullies and bluffs on both sides. Steep cuts exist on three of the four quadrants. Gullies and bluffs support a mixed forest of various tree and shrub species. Steep cuts above the highways support an open scrub composed of grasses and scattered shrubs although areas with largely bare soil predominate. Roadsides are vegetated with a weedy assemblage of species, usually annuals.

Field studies to assess the botanical resources along the proposed highway interchange were conducted in August 1989. The primary objectives of the field studies were to (1) describe the major vegetation types; (2) inventory the terrestrial, vascular plants; and (3) search for threatened and endangered species.

SURVEY METHODS

Prior to undertaking the field survey, a search was made of the pertinent literature to familiarize the principal investigator with other botanical studies conducted in the general area.

Topographic maps and recent aerial photographs were examined to determine access, terrain characteristics, vegetation patterns, and potential logistical and technical problems. Acess onto most of the study area was from along the highways and Auloa and the Old Kalaniana'ole roads. Well-maintained service trails can be found beneath the powerlines crossing the study site. In addition, there are several trails or footpaths running parallel to most of the highways, particularly behind the Hawaii Loa athletic field. One of these trails continues up along the bluff and road cut above Kalaniana'ole Highway.

A walk-through survey method was used. Notes were made on plant associations and distribution, substrate types, exposure, slope, etc. Species were identified in the field; those which could not be positively determined were collected for later identification in the herbarium and for comparison with the taxonomic literature. The species recorded are indicative of the season and environmental conditions under which the survey was conducted. A survey taken at a different time of the year and under varying environmental conditions would no doubt yield slight variations in the species checklist, especially of the weedy, annual taxa.

DESCRIPTION OF THE VEGETATION

There have been a number of previous surveys in the vicinity of the proposed highway interchange (Kores and Davis 1979; Linney and Char 1988; Char 1989). Around the area of the Kapa'a Quarry and the Kailua Drive-In Theater, vegetation is described as low- to high-stature scrub on steep ridges and tall-canopy forest in gulches and more or less flat areas. Along the Old Kalaniana-'ole Highway, vegetation consisted of a mixed forest with blocks of forestry plantings. In all of these studies, no threatened or endangered plant species were found. A few native plants such as 'ohi'a (Metrosideros polymorpha), 'akia (Wikstroemia oahuensis), uluhe (Dicranopteris linearis), ko'oko'olau (Bidens sandvicensis), huehue (Cocculus trilobus), and u'ulei (Osteomeles anthyllidifolia) occurred on these sites.

In this report, three vegetation types are recognized from the area along the proposed highway interchange: (1) mixed forest; (2) open scrub; and (3) roadside vegetation.

1. Mixed Forest

In gullies and other low-lying areas as well as some bluffs, a tall-stature forest composed primarily of Java plum (Syzygium cumini) along with scattered trees of other species such as mango (Mangifera indica), African tulip (Spathodea campanulata), kukui (Aleurites moluccana), Chinese banyan (Ficus microcarpa), silk oak (Grevillea robusta), etc., can be found. Stands of forestry plantings consisting of paperbark (Melaleuca quinquenervia) and Norfolk Island pine (Araucaria heterophylla) occur in this vegetation type; a large planting can be found on the slopes above Pali Highway, near a large, single family residence.

Fiddlewood (Citharexylum caudatum), guava (Psidium guajava), and Christmas berry (Schinus terebinthifolius) are generally the major understory plants, although, in places, saplings of the tree species mentioned previously, especially Java plum, may sometimes be dense.

Where the tree canopy is closed and the ground below heavily shaded, basketgrass (Oplismenus compressus) and dicliptera (Dicliptera chinensis) are the dominant ground cover. Along the edges of the forest or where the canopy cover is open, the kinds and numbers of plants are greater. Locally common in these areas are hairy sword fern (Nephrolepis multiflora), nettle-leaved vervain (Stachytarpheta urticifolia), Spanish clover (Desmodium incanum), sensitive plant (Mimosa pudica), downy woodfern (Christella dentata), and palmgrass (Setaria palmifolia).

The thorny wait-a-bit (Caesalpinia sepiaria), a rambling climber, can be found on trees and shrubs in the forest behind Hawaii Loa College. Maile-pilau (Paederia foetida), a vine, is abundant within the project area and forms dense mats over the tops of trees and shrubs.

2. Open Scrub

This vegetation type occurs on the bluffs and cuts above the highways. Molassesgrass (Melinis minutiflora), hairy sword fern, uluhe (Dicranopteris linearis), and broomsedge (Andropogon virginicus) are the most abundant components of this vegetation type. Trees and shrubs occur as scattered individuals or small clumps of plants and include Java plum, fiddlewood, guava, Christmas berry, Eucalyptus sp., and paberbark. On cuts on slopes above the highway, sparsely vegetated or bare soil areas may make up to 50% of the cut area.

A number of native species occur in the open scrub, especially adjacent to or on the cuts, these include 'ohi'a tree saplings, the matted uluhe fern, 'akia shrubs (Wikstroemia oahuensis), pala'a ferns (Sphenomeris chinensis), and the native club moss or wawae-'iole (Lycopodium cernuum).

3. Roadside Vegetation

Plants found alongside the margins of highways and roads tend to be weedy in nature as they are subject to frequent disturbances such as herbicide treatment, mowing, and vehicular and pedastrian traffic. No one particular species or small group of species is dominant, but rather a varied association of many different species characterizes the roadside or ruderal vegetation.

Some species are distributed along almost the entire length of the highways and roadways; these include ricegrass (Paspalum scrobiculatum), oriental hawksbeard (Youngia japonica), maile hohono (Ageratum conyzoides), crabgrass (Digitaria ciliaris), phyllanthus weed (Phyllanthus debilis), two species of Emilia, and beggar's tick (Bidens alba, Bidens pilosa). Others, as Australian brass buttons (Cotula australis), prostrate indigo (Indigofera spicata), and beach wiregrass (Dactyloctenium aegyptium) are more restricted and occur only in one or two places along the highway.

DISCUSSION AND RECOMMENDATIONS

Vegetation along the proposed highway interchange is dominated by introduced plant species. Gullies and bluffs are vegetated by a mixed forest composed of various tree and shrub species, among them Java plum, fiddlewood, African tulip, monkeypod, and guava. Cuts on slopes and some bluff areas are covered by a low, open scrub. Roadside areas support a weedy assortment of species largely adapted to frequent disturbances.

Of a total of 147 species inventoried during the field studies, 129 (88%) are introduced or alien species; 9 (6%) are originally of Polynesian introduction; and 9 (6%) are native. Of the native plants, 6 are indigenous, i.e., native to the Hawaiian Islands and elsewhere, and 3 are endemic, ie., native only to the islands.

There is little of botanical interest or concern along the proposed highway interchange, as almost all the area is dominated by introduced species, and certain portions appear to have been disturbed at one time or another. The proposed project is not expected to have a significant negative impact on the total island populations involved. The native species occur in similar environmental conditions throughout the islands. None are officially listed threatened or endangered species; nor are any candidate or proposed for such status (U. S. Fish and Wildlife Service 1985; Herbst 1987).

Areas disturbed by construction activities should be revegetated as soon as possible. Where feasible, it might be desirable to landscape with native plants already found on the study area. These species are adapted to the local conditions of the site. Plants of Polynesian introduction may also be considered. Natives and Polynesian species include 'ohi'a, 'akia, mamaki, ti, hau, kukui, etc. A number of others could also be used if needed. Some of the existing, large trees along the proposed interchange, such as the monkeypods, should be transplanted and used in the new landscaping, wherever possible.

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PLANT SPECIES CHECKLIST -- Castle Junction Interchange Project

Following is a checklist of all those vascular plant species inventoried during the field studies. Plant families are arranged alphabetically within each of four groups: Ferns and Fern Allies, Gymnosperms, Monocots, and Dicots. Taxonomy and nomenclature of the Ferns and Fern Allies are in accordance with Lamoureux (1984); Gymnosperms follow St. John (1973); and the flowering plants (Monocots and Dicots) are in accordance with Wagner et al. (in press). In most cases, common English and/or Hawaiian names given follow St. John (1973) or Porter (1972).

For each species, the following information is provided:

1. Scientific name with author citation.
2. Common English and/or Hawaiian name, when known.
3. Biogeographic status. The following symbols are used:
   - E = endemic = native only to the Hawaiian Islands
   - I = indigenous = native to the islands and also to one or more other geographic area(s)
   - P = Polynesian = plants of Polynesian introduction prior to Western contact; not native
   - X = introduced or alien = all those plants brought to the islands intentionally or accidentally after Western contact (1778); not native.
4. Presence (+) or absence (-) of a particular species within each of three vegetation types recognized on the project site (see text for discussion):
   - mf = Mixed Forest
   - os = Open Scrub
   - r = Roadside Vegetation

Scientific Name	Common Name	Status	Vegetation Type mf	os	r
FERNS & FERN ALLIES					
GLEICHENIACEAE (Vine Fern Family)					
Dicranopteris linearis (Burm.) Underw.	uluhe	I	+	+	-
LINDSAEACEAE (Lace Fern Family)					
Sphenomeris chinensis (L.) Maxon	pala'a, palapala'a	I	+	+	+
LYCOPODIACEAE (Club Moss Family)					
Lycopodium cernuum L.	wawae-'iole	I	-	+	-
NEPHROLEPIADACEAE (Sword Fern Family)					
Nephrolepis multiflora (Roxb.) Jarrett ex Morton	hairy sword fern, kupukupu	X	+	+	+
POLYPODIACEAE (Common Fern Family)					
Phymatosorus scolopendria (Burm.) Pic.-Ser.	laua'e, lauwa'e	X	+	-	-
THELYPTERIDACEAE (Downy Woodfern Family)					
Christella dentata (Forsk.) Brownsey & Jermy	downy woodfern	X	+	-	-
Christella parasitica (L.) Levl.	woodfern, oakfern	X	+	-	-
GYMNOSPERMS					
ARAUCARIACEAE (Araucaria Family)					
Araucaria heterophylla (Salisb.) Franco	Norfolk Island pine	X	+	-	-

Scientific Name	Common Name	Status	Vegetation Type mf	os	r
MONOCOTS					
AGAVACEAE (Agave Family)					
Cordyline fruticosa (L.) A. Chev.	ti, ki	P	+	–	–
Cordyline fruticosa (cultivar)	red ti	X	+	+	–
ARACEAE (Arum Family)					
Alocasia macrorrhiza (L.) Schott	'ape	P	+	–	–
Syngonium podophyllum Schott	syngonium	X	+	–	–
ARECACEAE (Palm Family)					
Cocos nucifera L.	coconut, niu	P	+	–	–
Roystonea sp.	royal palm	X	+	–	–
COMMELINACEAE (Spiderwort Family)					
Commelina diffusa N. L. Burm.	honohono	X	–	–	+
CYPERACEAE (Sedge Family)					
Kyllinga nemoralis (J. R. Forster & G. Forster) Dandy ex Hutchinson & Dalziel	white kyllinga	X	–	–	+
Pycreus polystachyos (Rottb.) P. Beauv.	pycreus	I	–	+	+
DIOSCOREACEAE (Yam Family)					
Dioscorea pentaphylla L.	pi'ia	P	+	–	–
HELICONIACEAE (Heliconia Family)					
Heliconia sp.	heliconia	X	+	–	–
MUSACEAE (Banana Family)					
Musa X paradisiaca L.	banana, maia	P	+	–	–
ORCHIDACEAE (Orchid Family)					
Arundina graminifolia (D. Don) Hochr.	bamboo orchid	X	–	+	–
Spathoglottis plicata Blume	Philippine ground orchid	X	+	+	–

Scientific Name	Common Name	Status	Vegetation Type mf	os	r
PANDANACEAE (Screw Pine Family)					
Pandanus tectorius S. Parkinson ex Z.	hala	I?	+	-	-
POACEAE (Grass Family)					
Andropogon virginicus L.	broomsedge	X	+	+	-
Brachiaria mutica (Forssk.) Stapf	California grass	X	+	+	+
Chloris divaricata R. Br.	stargrass	X	-	-	+
Chrysopogon aciculatus (Retz.) Trin.	golden beardgrass, manienie 'ula	X	-	+	-
Coix lachryma-jobi L.	Job's tears	X	+	-	-
Cynodon dactylon (L.) Pers.	Bermuda grass, manienie	X	-	+	+
Dactyloctenium aegyptium (L.) Willd.	beach wiregrass	X	-	-	+
Digitaria ciliaris (Retz.) Koeler	crabgrass	X	-	-	+
Digitaria insularis (L.) Mez. ex Ekman	sourgrass	X	-	-	+
Eleusine indica (L.) Gaertn.	wiregrass, goose grass	X	-	-	+
Melinis minutiflora P. Beauv.	molassesgrass	X	+	+	+
Oplismenus compressus (L.) P. Beauv.	basketgrass	X	+	-	-
Panicum maximum Jacq.	Guinea grass	X	+	-	+
Paspalum conjugatum Bergius	Hilo grass, mau'u Hilo	X	+	+	+
Paspalum dilatatum Poir.	Dallis grass	X	+	+	+
Paspalum fimbriatum Kunth	fimbriate paspalum	X	-	-	+
Paspalum scrobiculatum L.	ricegrass	X	+	+	+
Pennisetum purpureum Schumach	elephant grass, Napier grass	X	+	-	+
Phyllostachys sp.?	bamboo	X	+	+	-
Rhynchelytrum repens (Willd.) Hubb.	Natal redtop	X	-	-	+
Saccharum officinarum L.	sugar cane, ko	P	+	-	-
Sacciolepis indica (L.) Chase	Glenwoodgrass	X	-	+	-
Setaria gracilis Kunth	yellow foxtail, mau'u Kaleponi	X	-	-	+
Setaria palmifolia (J. Konig.) Stapf	palmgrass	X	+	-	+

Scientific Name	Common Name	Status	Vegetation Type mf	os	r
Sorghum halpense (L.) Pers.	Johnson grass	X	-	-	+
Sporobolus indicus (L.) R. Br.	West Indian dropseed	X	-	-	+
ZINGIBERACEAE (Ginger Family)					
Alpinia zerumbet (Pers.) B. L. Burtt & R. M. Sm.	shell ginger	X	+	-	-
Hedychium coronarium J. Konig.	white ginger	X	-	+	-
Hedychium flavescens N. Carey ex Roscoe	yellow ginger	X	+	-	-
DICOTS					
ACANTHACEAE (Acanthus Family)					
Dicliptera chinensis (L.) Juss.	dicliptera	X	+	-	-
Ruellia prostrata Poir.	ruellia	X	+	-	+
Ruellia sp.	ruellia	X	+	-	-
Thunbergia grandiflora Roxb.	blue-flowered thunbergia	X	+	-	+
ANACARDIACEAE (Mango Family)					
Mangifera indica L.	mango, manako	X	+	-	-
Schinus terebinthifolius Raddi	Christmas berry, wilelaiki	X	+	+	+
APIACEAE (Parsley Family)					
Centella asiatica (L.) Urb.	Asiatic pennywort, pohe kula	X	+	+	-
Ciclospermum leptophyllum (Pers.) Sprague	apium, fir-leaved celery	X	-	-	+
ARALIACEAE (Ginseng Family)					
Schefflera actinophylla (Endl.) Harms.	octopus tree	X	+	+	-
ASTERACEAE (Sunflower Family)					
Ageratina riparia (Regel) R. King & H. Robinson	pamakani	X	-	-	+
Ageratum conyzoides L.	maile hohono	X	-	-	+

Scientific Name	Common Name	Status	Vegetation Type mf	os	r
Bidens alba var. radiata (Schultz-Bip.) Ballard ex Melchert	white-flowered beggar's tick	X	+	+	+
Bidens pilosa L.	Spanish needle, beggar's tick	X	-	+	+
Calyptocarpus vialis Less.	hierba del cabello	X	-	-	+
Conyza canadensis (L.) Cronq.	hairy horse weed, 'ilioha	X	-	-	+
Cotula australis (Sieber ex Spreng.) J. D. Hook.	Australian brass buttons	X	-	-	+
Crassocephalum crepidioides (Benth.) S. Moore	crassocephalum	X	-	-	+
Emilia coccinea (Sims) G. Don	emilia	X	+	+	+
Emilia fosbergii Nicolson	pualele	X	+	+	+
Galinsoga parviflora Cav.	galinsoga	X	-	-	+
Pluchea symphytifolia (Mill.) Gillis	pluchea, sourbush	X	+	+	+
Synedrella nodiflora (L.) Gaertn.	synedrella	X	+	-	+
Taraxacum officinale W. W. Weber	common dandelion, laulele	X	-	-	+
Wedelia trilobata (L.) Hitchc.	wedelia	X	+	-	+
Youngia japonica (L.) DC	oriental hawksbeard	X	+	-	+
BIGNONIACEAE (Bignonia Family)					
Spathodea campanulata P. Beauv.	African tulip tree	X	+	-	-
BRASSICACEAE (Mustard Family)					
Lepidium virginicum L.	lepidium, peppergrass	X	-	-	+
CARICACEAE (Papaya Family)					
Carica papaya L.	papaya, mikana	X	+	-	-
CASUARINACEAE (Casuarina Family)					
Casuarina equisetifolia L.	common ironwood	X	+	+	-
CECROPIACEAE (Cecropia Family)					
Cecropia obtusifolia Bertol.	guarumo	X	+	-	-

Scientific Name	Common Name	Status	Vegetation Type mf	os	r
CONVOLVULACEAE (Morning-glory Family)					
Ipomoea alba L.	moon flower, koali-pehu	X	+	-	-
Ipomoea indica (J. Burm.) Merr.	koali-'awania	X	+	+	-
Ipomoea obscura (L.) Ker-Gawl.	field bindweed	X	-	-	+
Ipomoea triloba L.	little bell	X	-	-	+
Merremia tuberosa (L.) Rendle	wood rose	X	+	-	-
EUPHORBIACEAE (Spurge Family)					
Aleurites moluccana (L.) Willd.	kukui, tutui	P	+	-	-
Chamaesyce hirta (L.) Millsp.	hairy spurge, garden spurge	X	-	-	+
Chamaesyce hypericifolia (L.) Millsp.	graceful spurge	X	-	-	+
Chamaesyce prostrata (Aiton) Small	prostrate spurge	X	-	-	+
Codiaeum variegatum (L.) Bl.	croton	X	+	-	-
Phyllanthus debilis Klein ex Willd.	phyllanthus weed	X	-	-	+
FABACEAE (Pea Family)					
Acacia confusa Merr.	Formosan koa	X	-	+	-
Alysicarpus vaginalis (L.) DC	alysicarpus	X	-	-	+
Caesalpinia decapetala (Roth) Alston	wait-a-bit, Mysore thorn	X	+	-	-
Chamaecrista nictitans (L.) Moench	partridge pea, lauki	X	-	+	-
Desmanthus virgatus (L.) Willd.	slender mimosa	X	-	-	+
Desmodium incanum DC	Spanish clover, ka'imi	X	+	+	+
Desmodium sandwicense E. Mey.	Spanish clover	X	-	-	+
Desmodium triflorum (L.) DC	three-flowered beggarweed	X	-	+	+
Indigofera spicata Forssk.	prostrate indigo	X	-	-	+
Leucaena leucocephala (Lam.) de Wit	koa-haole	X	+	+	-
Medicago lupulina L.	black medic	X	-	-	+
Mimosa pudica var. unijuga (Duchass. & Walp.) Griseb.	sensitive plant, pua hilahila	X	+	+	+
Pithecellobium dulce (Roxb.) Benth.	'opiuma	X	+	-	-
Samanea saman (Jacq.) Merr.	monkeypod	X	+	+	-
Senna occidentalis (L.) Link	coffee senna, 'auko'i	X	-	-	+

Scientific Name	Common Name	Status	Vegetation Type mf	os	r
Senna surattensis (N. L. Burm.) H. Irwin & Barneby	kolomona, kalamona	X	+	-	-
Stylosanthes fruticosa (Retz.) Alston	stylosanthes	X	-	+	-
LAMIACEAE (Mint Family)					
Hyptis pectinata (L.) Poit.	comb hyptis	X	+	-	-
LAURACEAE (Laurel Family)					
Cinnamomum verum J. Presl.	cinnamomon	X	+	-	-
Persea americana Mill.	avocado, alligator pear	X	+	-	-
LYTHRACEAE (Loosestrife Family)					
Cuphea carthagenensis (Jacq.) Macbr.	cuphea, puakamoli	X	-	-	+
MALVACEAE (Mallow Family)					
Hibiscus tiliaceus L.	hau	I?	+	-	-
MELASTOMATACEAE (Melastome Family)					
Clidemia hirta (L.) D. Don	clidemia, Koster's curse	X	+	+	+
Pterolepis glomerata (Rottb.) Miq.	pterolepis	X	+	-	-
MELIACEAE (Mahagony Family)					
Melia azedarach L.	China berry, Nim tree	X	+	-	-
MORACEAE (Mulberry Family)					
Ficus microcarpa L. f.	Chinese banyan	X	+	+	-
MYRSINACEAE (Myrsine Family)					
Ardisia crenata Sims	Hilo holly	X	+	-	-
MYRTACEAE (Myrtle Family)					
Eucalyptus sp.	eucalyptus	X	-	+	-
Melaleuca quinquenervia (Cav.) S. T. Blake	paperbark	X	+	+	-

Scientific Name	Common Name	Status	Vegetation Type mf	os	r
Metrosideros polymorpha Gaud.	'ohi'a, 'ohi'a-lehua	E	+	+	-
Psidium cattleianum Sabine	strawberry guava, waiawi	X	-	+	-
Psidium guajava L.	guava, kuawa	X	+	+	+
Syzygium cumini (L.) Skeels	Java plum, palama	X	+	+	+
OXALIDACEAE (Wood Sorrel Family)					
Oxalis corniculata L.	yellow wood sorrel, 'ihi	P?	+	+	+
PASSIFLORACEAE (Passion Flower Family)					
Passiflora edulis Sims	passion fruit, liliko'i	X	-	+	-
Passiflora foetida L.	pohapoha	X	-	+	-
Passiflora laurifolia L.	yellow granadilla	X	+	-	-
Passiflora suberosa L.	huehue-haole	X	+	-	-
PLANTAGINACEAE (Plantain Family)					
Plantago lanceolata L.	narrow-leaved plantain	X	-	-	+
Plantago major L.	common plantain, laukahi	X	-	-	+
PROTEACEAE (Protea Family)					
Grevillea robusta A. Cunn. ex R. Br.	silk oak	X	+	-	-
ROSACEAE (Rose Family)					
Rubus rosaefolius Sm.	thimbleberry	X	+	+	+
RUBIACEAE (Coffee Family)					
Morinda citrifolia L.	noni	P	-	+	-
Paederia scandens (Lour.) Merr.	maile pilau	X	+	+	+
Spermococe assurgens Ruiz & Pav.	buttonweed	X	+	-	+
SAPINDACEAE (Soapberry Family)					
Euphoria sp.?	longan	X	+	-	-
SOLANACEAE (Nightshade Family)					
Solanum mauritianum Scop.	pua nana honua	X	+	-	-

Scientific Name	Common Name	Status	Vegetation Type mf	os	r
THYMELAEACEAE (Akia Family)					
Wikstroemia oahuensis (A. Gray) Rock	'akia	E	+	+	−
URTICACEAE (Nettle Family)					
Pilea microphylla (L.) Liebm.	artillary plant, rockweed	X	−	−	+
Pipturus albidus (Hook. & Arnott) A. Gray	mamaki	E	+	−	−
VERBENACEAE (Verbena Family)					
Citharexylum caudatum L.	fiddlewood	X	+	+	−
Stachytarpheta dichotoma (Ruiz & Pav.) Vahl	vervain	X	−	+	−
Stachytarpheta urticifolia (Salisb.) Sims	nettle-leaved vervain	X	+	+	+
Verbena litoralis Kunth	owi,oi	X	−	+	−

Appendix E

FAUNAL SURVEY

SURVEY OF THE AVIFAUNA AND FERAL MAMMALS AT THE SITE OF THE PROPOSED CASTLE JUNCTION INTERCHANGE, KANEOHE, OAHU

Prepared for

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24 August 1989

SURVEY OF THE AVIFAUNA AND FERAL MAMMALS AT THE SITE OF THE PROPOSED CASTLE JUNCTION INTERCHANGE, KANEOHE, OAHU

INTRODUCTION

The purpose of this report is to summarize the findings of a 4 day (12,26,28 July, 17 August 1989) bird and mammal field survey at the site of a proposed Castle Junction interchange in Kaneohe, Oahu (see Fig.1 for exact location of area surveyed). Also included are references to pertinent literature as well as unpublished reports.

The objectives of this field survey were:

1- Document what bird and mammal species occur on the property or may likely occur given the range of habitats available.

2- Provide some baseline data on the relative abundance of each species.

3- Supplement, where necessary, these findings with published and/or unpublished data.

4- Evaluate the possible changes that might occur in the bird and mammal populations at this site following the proposed development of the property.

5- Finally, if any threatened or endangered species occur on the property identity their use of the site and any features of the habitat that are important for their survival. If essential resources are found suggest how these may be best protected.

GENERAL SITE DESCRIPTION

The proposed project site is located on Windward Oahu (see Fig.1). The topography of the area is steep with ravines and ridges covered in second growth exotic forest. Portions of the site also contain lawns, parking lots and roads. Both open parkland habitat as well as dense second growth exotic forest characterize most of the property.

Weather during the field survey was variable with clear periods and occasional light showers. Winds were generally NE trades.

STUDY METHODS

Field observations were made with the aid of binoculars and by listening for vocalizations. These observations were concentrated during the peak activity periods of early morning and late afternoon. Attention was also paid to the presence of tracks and scats as indicators of bird and mammal activity.

The four survey days were not consecutive but were deliberately spread through two months in order to be able to census the fauna over a broader window time to account for migratory birds which begin to arrive in Hawaii in August from their artic breeding grounds.

At various locations (see Fig.1) eight minute count stations were established and repeatedly censused on each of the survey dates. All birds and mammals seen or heard were recorded during these eight minute census periods. Between these count stations walking tallys of birds and mammals seen or heard were also kept. These counts provide the basis for the population estimates given in this report. Census data on birds contained in the annual Christmas bird surveys conducted by the Hawaii Audubon Society were also consulted along with unpublished records and reports of birds from this general habitat type in Windward Oahu in order to acquire a more complete picture of possible avifauna activity on the site (Pyle 1987, 1988, Bruner 1989). Observations of feral mammals were limited to visual sightings and evidence in the form of scats and tracks. No attempts were made to trap mammals in order to obtain data on their relative abundance and distribution.

Scientific names used herein follow those given in the most recent American Ornithologist's Union Checklist (A.O.U. 1983), Hawaii's Birds (Hawaii Audubon Society 1984), Field Guide to the Birds of Hawaii and the Tropical Pacific (Pratt et al. 1987) and Mammal species of the World (Honacki et al. 1982).

RESULTS AND DISCUSSION

Resident Endemic (Native) Land Birds:

No endemic landbirds were recorded during the course of the field survey. Endemic landbirds have not been recorded in the literature at this site but three species ; Elepaio (Chasiempis sandwichensis), Pueo or Hawaiian Owl (Asio flammeus sandwichensis) and Common Amakihi (Hemignathus virens) may occur infrequently in the upper elevations of the property. For the most part, however, the habitats and elevation at this site are probably unsuitable for endemic landbirds.

Resident Indigenous (Native) Birds:

No resident indigenous birds were recorded at this site. Black-crowned Night Heron (Nycticorax nycticorax) may on occasion roost in the area or overfly the property on its way to nearby wetlands.

Migratory Indigenous (Native) Birds:

Pacific Golden Plover (Pluvialis fulva) - A total of eight plover were recorded on the lawn area of the property. Plover arrive in Hawaii in early August and depart to their arctic breeding grounds during the last week of April. Johnson et al. (1981) and Bruner (1983) have shown plover are extremely site-faithful on their wintering grounds and many establish lifelong foraging territories which they vigorously defend.

Such behavior makes it possible to acquire a fairly good estimate of the abundance of plover in any one area. These populations likewise remain relatively stable over many years. The eight plover counted on this survey were all adults and have likely occuppied these lawns for several years. One other species of migratory bird that might utilize the lawn areas of the property is the Ruddy Turnstone (Arenaria interpres).

Resident Indigenous (Native) Seabirds:

Seabirds typically nest on offshore islands which are free from disturbance by dogs, cats, mongooses and rats. However, there are areas on the main islands were predators lack access and nesting can be successful (Bruner 1988). No seabirds were recorded nor would any be expected on this property. White-tailed Tropicbird (Phaeton lepturus) can be seen on the Windward side of Oahu as it flies from the sea towards the summit of the Koolau mountains.

Exotic (Introduced) Birds:

A total of 17 species of exotic birds were found during this field survey. Table One shows the species recorded on this survey and their relative abundance. The most abundant species were Zebra Dove (Geopelia striata), Red-vented Bulbul (Pycnonotus cafer), Common Myna (Acridotheres tristis), Japanese White-eye (Zosterops japonicus) and House Finch

(Carpodacus mexicanus). Exotic species not recorded on the actual survey but which potentially could occur at this locality include: Common Barn Owl (Tyto alba), Japanese Bush-warbler (Cettia diphone), Red-billed Leiothrix (Leiothrix lutea) and Northern Mockingbird (Mimus polyglottos) (Berger 1972, Hawaii Audubon Society 1984, Pratt et al. 1987, Pyle 1987, 1988). The latter species Northern Mockingbird prefers drier parkland habitat and thus may rarely occur at this site. Red-billed Leiothrix have experienced a rather rapid decline in numbers especially on Oahu in recent years. This cycle of population "boom and bust" is common and widespread in exotic species (Williams 1987). Japanese Bush-warbler are very shy retiring birds that usually make their presence known only when they sing. Their song is loud and distinct and can be heard over a remarkable distance. During late summer until December they are silent and hence almost impossible to detect on a census (Hawaii Audubon Society 1984, Pratt et al. 1987).

Red-vented Bulbul have become one of Oahu's most abundant species in recent years. The adaptability of this species to a variety of habitats and its remarkable population increase have been well documented (Williams 1983, Williams and Giddings 1984, Williams and Evenson 1985). Red-whiskered Bulbul (Pycnonotus jocosus) have remained more confined than their close relative the Red-vented Bulbul. Records for Red-whiskered Bulbul on the Windward side of Oahu are scarce. Bruner (1989) found P. jocosus on property adjacent and mauka of this site. This species may be limited in its ditribution by competition from Red-vented Bulbuls (Williams and Giddings 1984, Williams and Evenson 1985).

Java Sparrow (Padda oryzivora) have also experienced a population increase and expansion in recent years (Pratt et al. 1987). Their occurrence at this site was therefore not unexpected.

Feral Mammals:

Feral mammals observed during the survey included Roof Rat (Rattus rattus), Small Indian Mongoose (Herpestes auropunctatus) and cats. Without a trapping program it is difficult to conclude much about the relative abundance of these feral mammals, however, it is likely that their numbers are typical of what one would find elsewhere in similar habitat on Oahu.

Records of the endemic and endangered Hawaiian Hoary Bat (Lasiurus cinerus semotus) are sketchy but the species has been reported from Oahu (Tomich 1986). None were observed on this field survey. This species occurs in a variety of habitats frcm native forest to coastal and to urban (Bruner 1985). Our knowledge of the natural history of this bat is surprisingly limited. They roost in trees rather than caves and tend to be rather solitary in their habits. The extent of an individual's range and whether or not they are site-faithful is not known.

CONCLUSIONS

A brief field survey can at best provide a limited perspective of the wildlife present in any given area. Not all species will necessarily be observed and information on their use of the site must be sketched together from brief observations and the available literature. The number of species and the relative abundance of each species may vary throughout the year due to available resources and reproductive success. Species which are migratory will quite obviously be a part of the ecological picture only at certain times during the year. Exotic species sometimes prosper for a time only to later disappear or become a less significant part of the ecosystem (Williams 1987). Thus only long term studies can provide the insights necessary to acquire a complete understanding of the bird and mammal populations in a particular area. However, when brief studies are coupled with data gathered from other sources, ie. literature and unpublished reports, the value of the conclusions drawn are significantly increased.

The following are some broad conclusions related to bird and mammal activity on the proposed Castle Junction Interchange property:

1- The present environment provides a moderate range of habitats which are utilized by the typical array of exotic birds one would expect at this elevation and in this type of environment on Oahu.

2- The number of migratory birds (Pacific Golden Plover) found on the property was a little lower than would be expected in September or October when the adults are joined by the juveniles. The absence of native resident birds was not unexpected given the habitat and its elevation.

3- In order to obtain more data on mammals, a trapping program would be required. The brief observations of this survey did not reveal any unusual or unexpected mammal activity.

4- The proposed development will significantly alter the present habitat. The loss of the forest and lawn areas will effectively eliminate those birds and mammals which are found at this site. Some individuals may be able to relocate to adjacent lands but many may not be so successful if the adjacent areas are already at carrying capacity. Birds which are strongly site-attached and also territorial, such as Pacific Golden Plover will find it difficult to establish themselves elsewhere even if space were readily available (Bruner 1983). Despite the loss of habitat due to replacement of forest and parkland by a highway interchange the impact on the bird and mammal populations of Windward Oahu will be virtually unmeasurable. Thus the effect of this project on the overall fauna of Windward Oahu is insignificant.

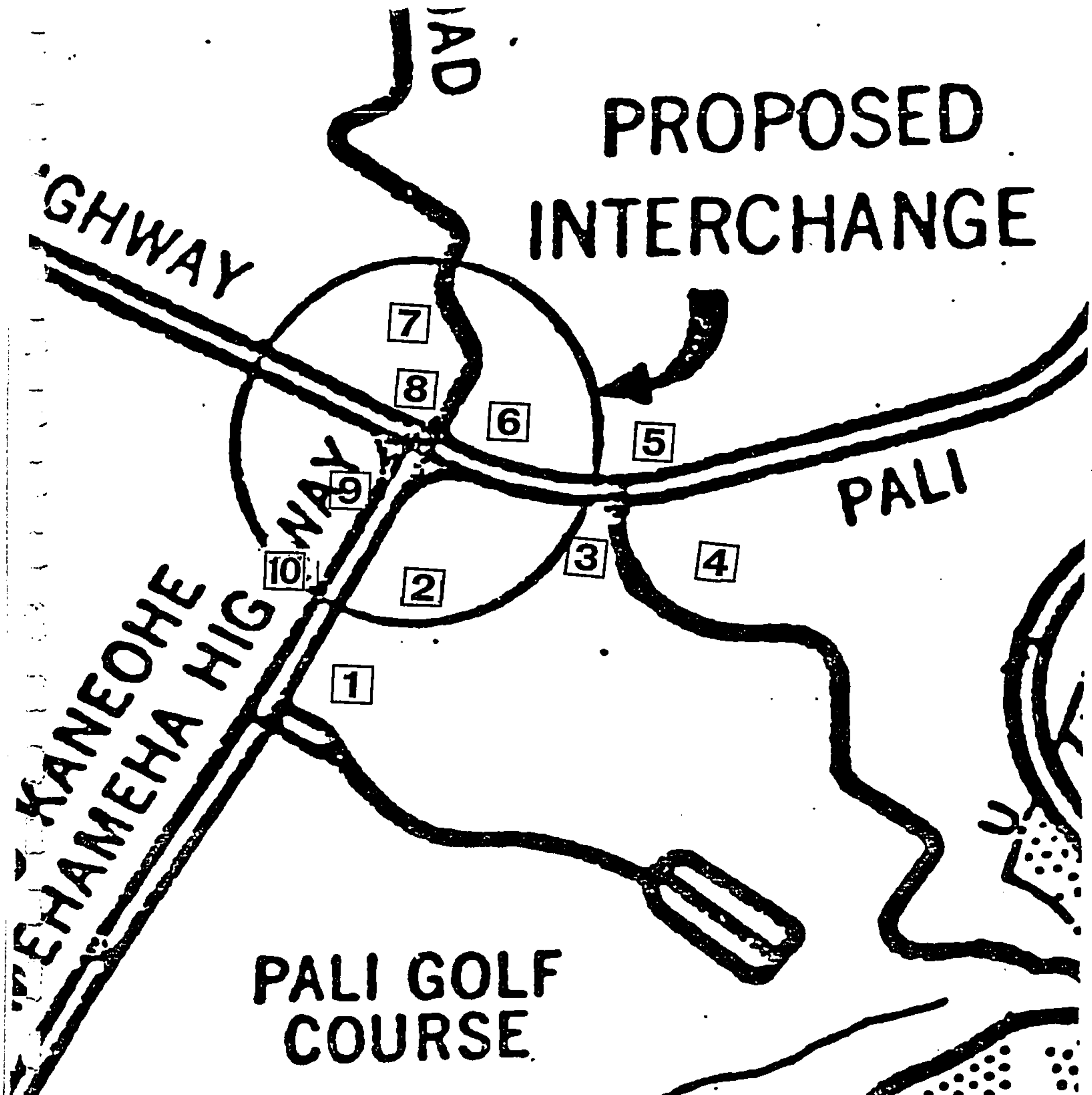

Fig. 1. Proposed project site with eight minute count stations used for censusing indicated by numbers enclosed within a box.

TABLE 1

Relative abundance of exotic birds at property proposed for the development of the Castle Junction Interchange, Kaneohe, Oahu.

COMMON NAME	SCIENTIFIC NAME	RELATIVE ABUNDANCE*
Cattle Egret	*Bubulcus ibis*	R = 2
Spotted Dove	*Streptopelia chinensis*	C = 6
Zebra Dove	*Geopelia striata*	A = 12
White-rumped Shama	*Copsychus malabaricus*	U = 2
Common Myna	*Acridotheres tristis*	A = 15
Chinese Thrush	*Garrulax canorus*	R = 1
Red-vented Bulbul	*Pycnonotus cafer*	A = 16
Red-whiskered Bulbul	*Pycnonotus jocosus*	R = 2
Red-crested Cardinal	*Paroaria coronata*	U = 2
Northern Cardinal	*Cardinalis cardinalis*	U = 4
Japanese White-eye	*Zosterops japonicus*	A = 18
House Sparrow	*Passer domesticus*	U = 4
House Finch	*Carpodacus mexicanus*	A = 11
Java Sparrow	*Padda oryzivora*	R = 8
Common Waxbill	*Estrilda astrild*	R = 6
Chestnut Mannikin	*Lonchura malacca*	R = 25
Nutmeg Mannikin	*Lonchura punctulata*	C = 9

* (see page 12 for key to symbols)

KEY TO TABLE 1

Relative abundance = number of individuals observed during walking survey or frequency on eight minute counts in appropriate habitat.

A = abundant (10+) on 8 min. counts

C = common (5-10) on 8 min. counts

U = uncommon (less than 5) on 8 min. counts

R = recorded but not on 8 min. counts (number which follows is total recorded for all four days of the survey)

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Appendix F

AIR QUALITY IMPACT ANALYSIS

CASTLE JUNCTION INTERCHANGE
AIR QUALITY IMPACT ASSESSMENT REPORT

Prepared for

PARSONS HAWAII

February 1990

Prepared by

ENGINEERING-SCIENCE, INC.
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AIR QUALITY

INTRODUCTION

The existing at grade intersection of FAP route 61 (Pali Highway - Kalanianaole Highway), FAP route 83 (Kamehameha Highway), and Auloa Road at Castle Junction is not able to handle the peak hour traffic at this intersection. A highway interchange providing grade separation is proposed to eliminate the present traffic congestion.

The project area is located in a rural setting in a mountainous area. It is surrounded by Hawaii Loa college to the north and Pali Golf Course to the southwest. Kaneohe Ranch House is located directly east of the intersection and the Castle House is located to the Southeast.

This report assesses the impacts of the proposed interchange on the local air quality during construction and operation. Emissions during the construction phase are emissions of fugitive dust from land preparation activities and exhaust emissions from heavy duty construction machinery. Impacts from the operation of the project are emissions from the vehicles using the interchange and are expected to decrease due to improved traffic flow. The impact on local ambient air quality is considered for three project alternatives as compared to a no-build option.

SETTING

Climate and Meteorology

The climate in Hawaii is mild and equable due to the small amount of seasonal variation in the amount of energy received from the sun and the tempering effect of the surrounding ocean. Maximum temperatures range from the high 70's in the winter to the mid 80's in the summer; minimum temperatures range from the mid 60's to the low 70's . Historical rainfall data from the Honolulu International Airport indicate an average rainfall of 23 inches. Northeast tradewinds predominate much of the year with a mean wind speed in the range of 8-12 mph. However, wind speeds are less than 10 mph more than a third of the time and stable climatological conditions (Pasquill-Gifford stability categories E,F and G) occur about 80% of the time. It is during these stable conditions that the greatest potential for pollution buildup from ground level sources exists.

Existing Air Quality

Air quality in the state of Hawaii is monitored by the State Department of Health (DOH). The DOH maintains a network of air monitoring stations throughout the state including seven on the island of Oahu. The Waimanalo monitoring station is located in the sparsely populated rural area on the windward side of the island approximately ten miles east northeast of downtown Honolulu and is the closest station to the project site. Data collected at this site would closely represent the air quality in the project area, unfortunately particulate matter is the only parameter monitored at this site. The next closest monitoring stations are those located at the Department of Health Building in Honolulu (particulate matter, carbon monoxide, sulfur dioxide and lead), and Waikiki City at 2131 Kalakula ave. in Waikiki (carbon monoxide). These stations are not considered to be representative of the project area because of their distance from the project site and their urban setting. Data from these sites are included in Table 1 for purposes of comparison, as these sites are felt to establish an upper bound on concentration levels due to their urban setting.

Table 1 indicates general compliance with state and federal ambient air quality standards. Carbon monoxide was the only pollutant exceeding state standards during the period of 1985-1987, and it was in excess on only one day at Honolulu in 1987. Because the project area is in a more rural setting than these monitoring stations, it is considered unlikely that the air quality there would be worse than that at the Honolulu or Waikiki stations.

TABLE 1

SUMMARY OF AIR QUALITY DATA 1985-1987

POLLUTANT	WAIMANALO			HONOLULU			WAIKIKI		
	1985	1986	1987	1985	1986	1987	1985	1986	1987
TOTAL SUSPENDED PARTICLES									
MAXIMUM 24 HOUR AVERAGE ug/m 3 CONCENTRATION	52	72	45	48	61	59			
DAYS EXCEEDING STATE STANDARD	0	0	0	0	0	0			
SULFUR DIOXIDE									
MAXIMUM 24 HOUR ug/m 3 CONCENTRATION				<5	6	11			
DAYS EXCEEDING STATE STANDARD				0	0	0			
CARBON MONOXIDE									
MAXIMUM 1 HOUR ug/m 3 CONCENTRATION				10.4	13.5	11.1	14.4	9.0	8.3
DAYS EXCEEDING STATE STANDARD				1	3	1	6	0	0
LEAD									
MAXIMUM QUARTERLY AVERAGE ug/m 3 CONCENTRATION				0.1	0.1	0.0			
DAYS EXCEEDING STATE STANDARD				0	0	0			

Table 2
SUMMARY OF FEDERAL AND STATE OF HAWAII
AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	Federal Primary Standard	Federal Secondary Standard	State Standard
Total Suspended Particulate Matter (TSP), ug/m^3	Annual Arithmetic Mean	-	-	60
	Maximum 24-hr Average	-	-	150
PM-10, ug/m^3	Annual Arithmetic Mean	50	-	-
	Maximum 24-hr Average	150	-	-
Sulfur Dioxide (SO_2), ug/m^3	Annual Arithmetic Mean	80	-	80
	Maximum 24-hr Average	365	-	365
	Maximum 3-hr Average	-	1,300	1,300
Nitrogen Dioxide (NO2), ug/m^3	Annual Arithmetic Mean	100	100	70
Carbon Monoxide (CO), mg/m^3	Maximum 8-hr Average	10	10	5
	Maximum 1-hr Average	40	40	10
Photochemical Oxidants (as O3), ug/m^3	Maximum 1-hr Average	235	235	100
Lead (Pb), ug/m^3	Maximum Quarterly Average	1.5	1.5	1.5

Air Quality Standards

A summary of the federal National Ambient Air Quality Standards (NAAQS) and the State of Hawaii ambient standards are presented in Table 2. The federal standards are divided into primary and secondary standards while those for the State of Hawaii are at a single level. Primary standards are intended to protect public health with an adequate margin of safety while secondary standards are designed to protect public welfare such as visibility, comfort levels, wildlife, vegetation, animal life, property, soils, water, climate and economic values. In general, the ambient standards of the State of Hawaii are the same as the federal primary or secondary standards. However, in the case of carbon monoxide and ozone, the state standards are more stringent. In April, 1986, the Governor of Hawaii signed amendments to Chapter 59 (Ambient Air Quality Standards) of the Hawaii Administrative Rules, making the state's standards for particulate matter and sulfur dioxide the same as national standards. On July 1, 1987 the U.S. Environmental Protection Agency (EPA) revised the standard for particulate matter to apply only to particles with an aerodynamic diameter of 10 microns or less (inhalable portion only). The State of Hawaii has not adopted the federal PM-10 standard, nor has it developed its own PM-10 standard, such that the state particulate matter standard is different from the federal standard.

The NAAQS are set in Title 40, Part 50 of the Code of Federal Regulations (40CFR50) while the ambient air quality standards for the State of Hawaii are defined in Chapter 11-59 of the Hawaii Administrative Rules.

AIR QUALITY IMPACTS

Construction Emissions

Emissions during the construction phase are generated from ground preparation activities and exhaust emissions from heavy duty construction machinery. In order to quantify exhaust emissions the construction and machinery mobilization schedules for the project are necessary. Because this schedule is not yet available, construction impacts are evaluated on a unit time basis of one month and an assumed composite of construction machinery and an assumed work schedule of 8 hours per day, 25 days a month. Round trip distances were assumed to be 100 miles for dump trucks and 50 miles for cement trucks. Monthly construction emissions are estimated using EPA emission factors and are presented in Table 3.

The emission factor developed by EPA provides a monthly estimate of 1.2 tons per acre of fugitive particulate emissions resulting from ground preparation activities. For an assumed project site of 4 acres, fugitive dust emissions would total 4.8 tons per month.

Table 3

MONTHLY CONSTRUCTION MACHINERY EXHAUST EMISSIONS

Equipment	Number of Units	Emissions, lbs/month				
		CO	HC	NO_x	SO_x	TSP
Grader	1	30	8	11	17	12
Bulldozer	3	1080	114	2496	324	153
Loader	2	52	100	756	73	68
Backhoe	1	135	31	338	29	28
Dump truck	3	138	48	285	54	54
Forklift	2	270	61	676	57	56
Crane	1	135	31	338	114	28
Cement truck	6	138	48	285	54	54

Operation Emissions

Emissions during the operation of the project will be mobile source emissions from the vehicular traffic using the project. The project's impact on air quality is considered to be the difference between the existing impact and the modified impact resulting from the project.

Because the project is expected to change the traffic flow rate, not the total volume, the total emissions from this traffic are expected to remain the same or decrease due to more efficient traffic movement.

In order to determine the impact from the project on local ambient CO concentrations, traffic studies and meteorological considerations were used in conjunction with Caline4, a dispersion model for predicting air pollutant concentrations near roadways, to determine the effect of the project on ambient carbon monoxide concentrations. Ambient CO concentrations were calculated using caline4 for the existing roadway and for alternatives A, B and C. Background concentrations were assumed to be zero to indicate the impact of traffic on localized CO concentrations. A uniform wind speed of 1 meter per second and stability category G was assumed as worst case parameters. The worst case option was used for the wind bearing. This option searches all wind angles and gives results for the angle which produces the highest pollutant levels. A receptor height of 1.3 meters was used to estimate the normal human breathing zone.

The results of the dispersion modeling studies are presented in Table 4 for comparison purposes. The model was run for project years 1995 and 2010 as well as 1988 for the existing intersection. The results presented represent the maximum predicted concentration at three receptors located near the intersection at the Kaneohe Ranch Office, the Castle House and the War Memorial. These receptor locations were chosen at or around the actual intersection where ambient concentrations are expected to be the greatest. Figures 1, 2, 3, and 4 present the receptor locations for the existing condition and the three project alternatives. Comparison of these results to the state standards shows that none of the receptors exceed the state standards for CO concentration for the existing or any of the options for any year evaluated. The predicted CO levels for all three project alternatives are significantly lower than the existing, or no build option. The general trend of lower curbside concentrations predicted for years further into the future is due to expected advances in vehicle efficiency. In the case of the existing alternative at the War Memorial receptor the predicted CO concentration was greatest for the year 1995. This is due to the fact that the predicted traffic increase on the road segments which have the greatest impact on this receptor is much grater from 1988 to 1995 than from 1995 to 2010. The increased traffic dominated over the increased vehicle efficiency for 1995, but increased efficiency dominated over increased traffic for 2010.

Table 4

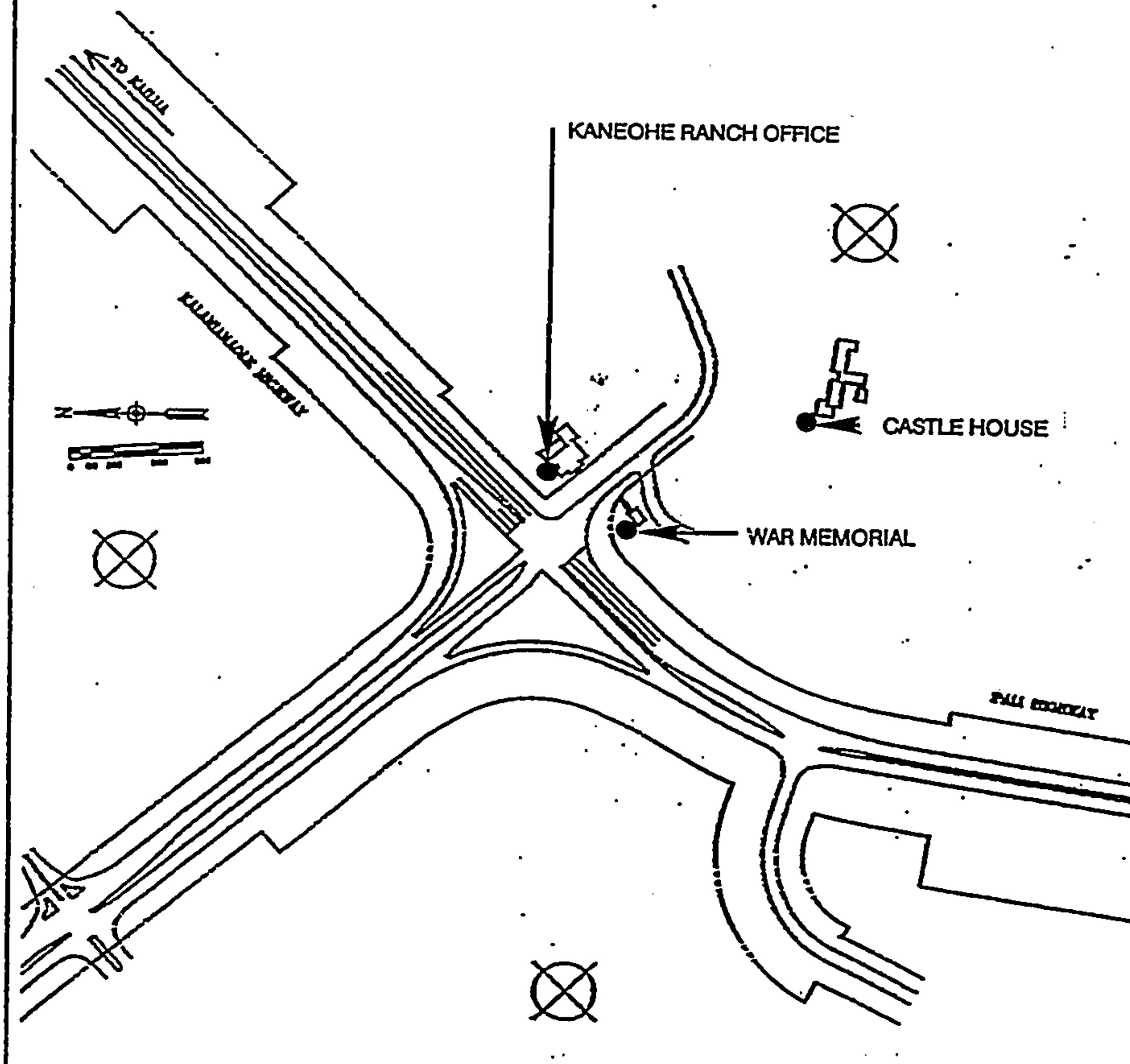
MAXIMUM CURBSIDE CARBON MONOXIDE CONCENTRATIONS

ALTERNATIVE/YEAR	CO Concentration, mg/m^3 Kaneohe Ranch	Castle House	War Memorial
Existing 1988	1.7	0.7	1.1
Existing 1995	1.3	0.6	1.3
Existing 2010	1.0	0.5	1.1
Alternative A 1995	0.5	0.3	0.5
Alternative A 2010	0.5	0.3	0.3
Alternative B 1995	1.1	0.3	1.1
Alternative B 2010	0.5	0.2	0.3
Alternative C 1995	0.7	0.5	0.7
Alternative C 2010	0.7	0.3	0.7

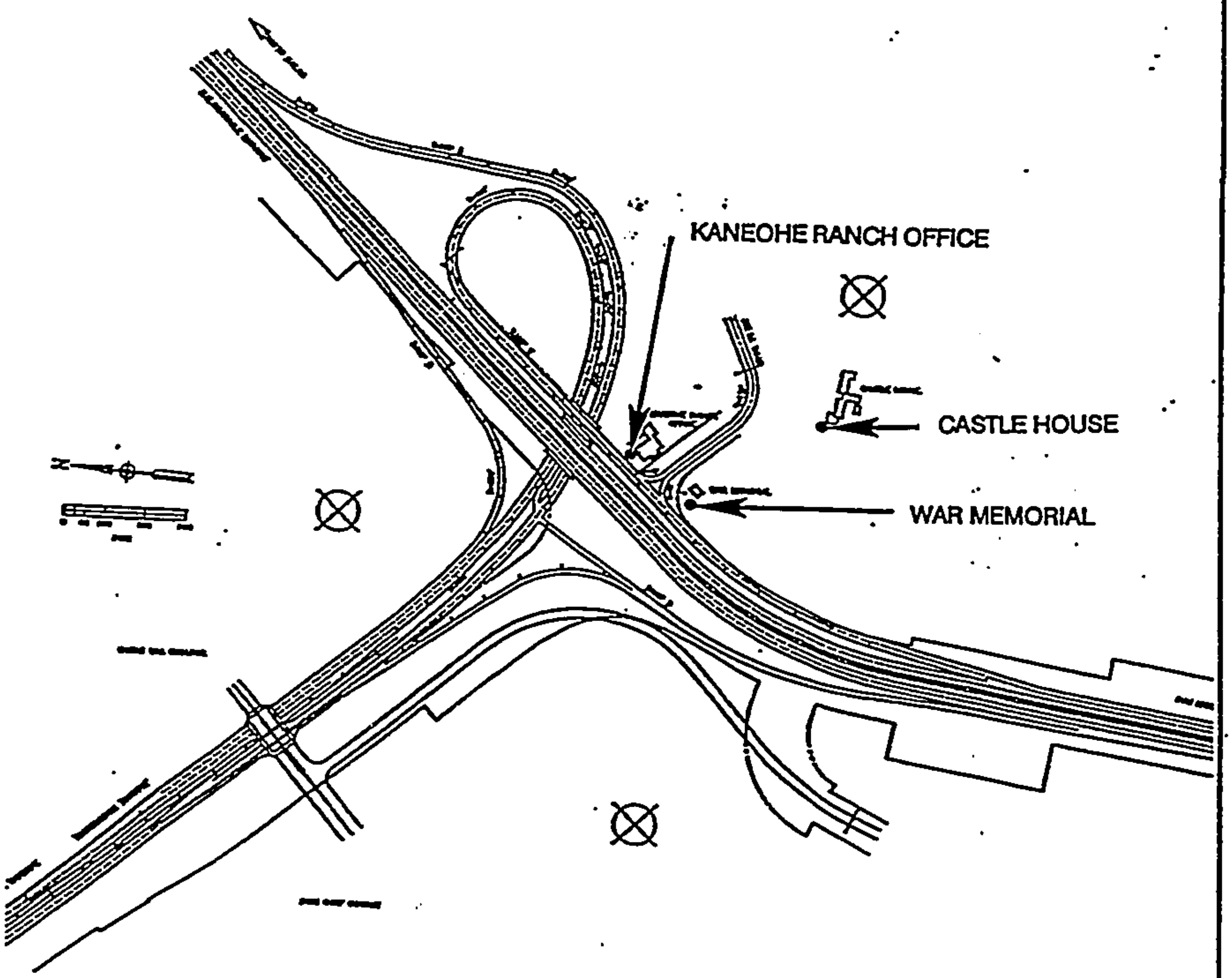
MITIGATION MEASURES

The impacts of heavy duty construction machinery exhaust should be minimized by keeping all equipment properly tuned and properly maintained as well as minimizing unnecessary idle time. To reduce fugitive dust emissions all exposed surfaces should be kept well watered and all vehicles leaving the site should be washed to prevent dirt from being carried onto adjacent streets. Co-ordination of all surfacing activities (concrete pouring and paving) with grading and excavation activities is recommended in order to minimize exposed soil and fugitive dust.

The impacts associated with the operation of this project are benificial, due to improved traffic flow and improved vehicular efficiency, therefore mitigation measures are not necessary.

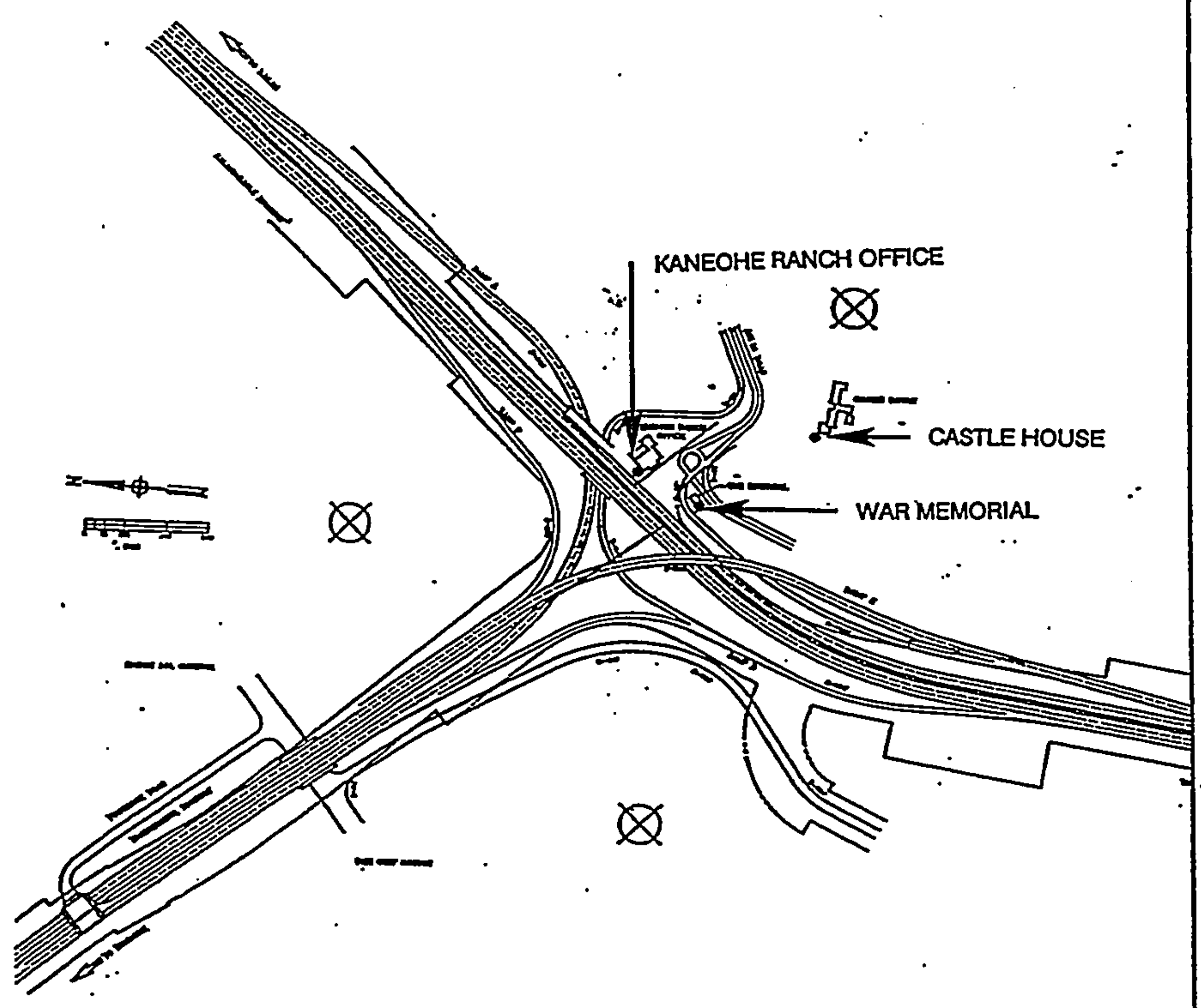


RECEPTOR LOCATION –EXISTING

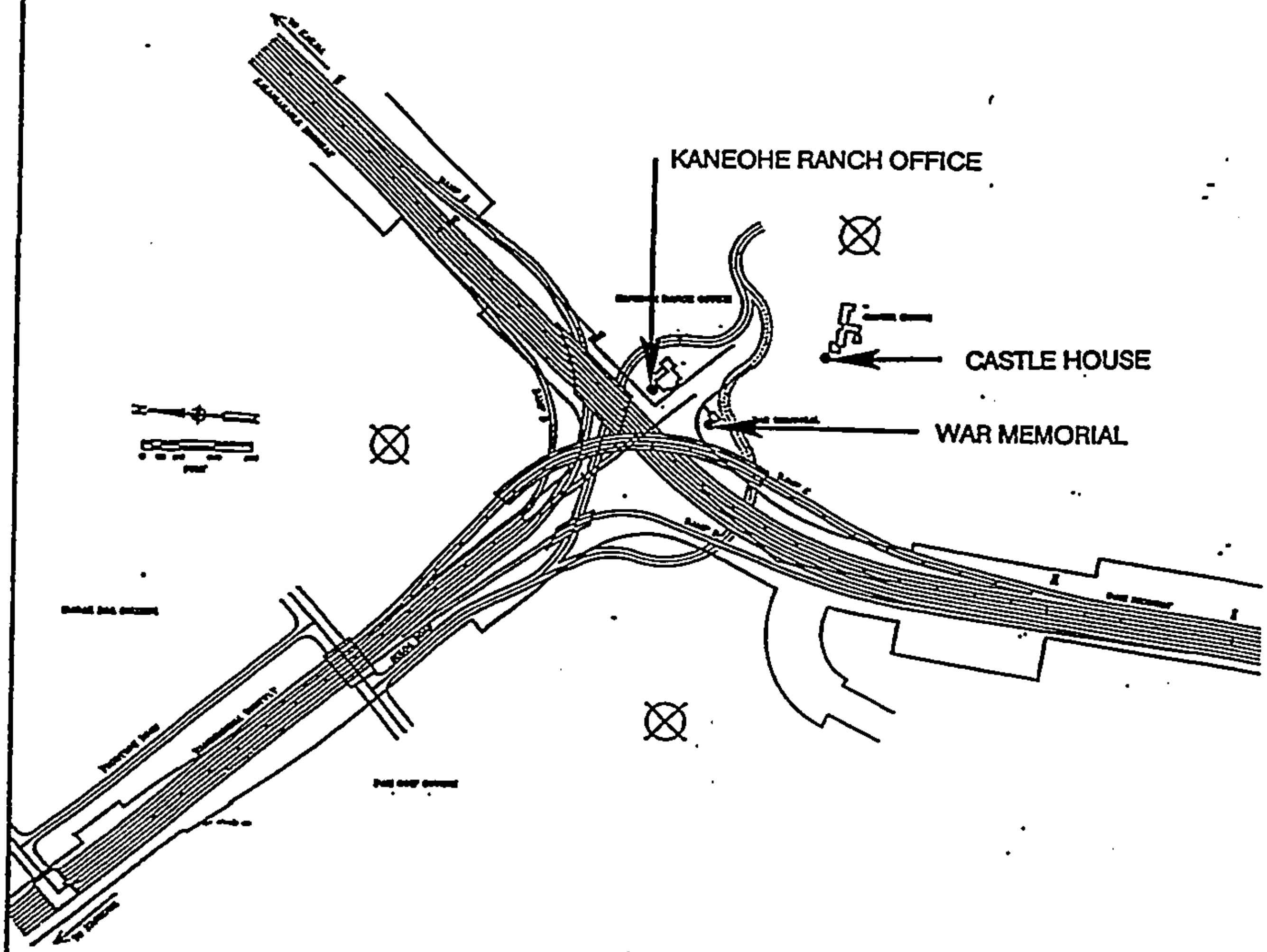


RECEPTOR LOCATION –ALTERNATIVE A

ENGINEERING–SCIENCE



RECEPTOR LOCATION –ALTERNATIVE B.



RECEPTOR LOCATION --ALTERNATIVE C

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Appendix G

ARCHAEOLOGY SURVEY

ARCHAEOLOGICAL RECONNAISSANCE
FOR THE CASTLE JUNCTION INTERCHANGE PROJECT
KAILUA AND KANE'OHE, KO'OLAUPOKO, O'AHU

by

Hallett H. Hammatt, Ph.D.
David W. Shideler, M.A.

prepared for

Parsons Hawaii

Cultural Surveys Hawaii
January, 1990

ABSTRACT

Cultural Surveys Hawaii was contracted by Parsons Hawaii to perform an archaeological reconnaissance of an approximately 20-acre tripodal-shaped parcel in association with the production of an EIS for the Castle Junction Interchange. The study area extends from the presently existing Castle Junction SSW along both sides of Nu'uanu Pali Highway for a distance of 1800', extends NE up both sides of Kalanianaole Highway for a distance of 1500', and extends NW along both sides of Kamehameha Highway for a distance of 1300'. The width of the reconnaissance corridor on either side of the highways was 400' in the vicinity of the present interchange and tapered to 100' wide in the distal portions of the project area. No prehistoric archaeological sites or cultural layers were encountered. A few minor recent historic features believed to be remnants of U.S. Army Camp Pali were observed. No significant historic sites other than the War Memorial boulder and the Kaneohe Ranch Business Office were encountered. Development activities within the project area would thus have no adverse impact on cultural resources, other than the War Memorial and ranch office and no further archaeological work is recommended.

In the opinion of Mr. Don Hibbard, State Historic Preservation Officer, proposed alternative A would not have an adverse impact on the Kaneohe Ranch Office Building but Alternative B or C would have an adverse impact. The choice of Alternatives B or C would thus require going through the "106 process" involving review by a federal historic preservation advisory committee. As no mitigation would seem possible the choice of Alternatives B or C could be highly problematic and would certainly be time consuming. We recommend the adoption of Alternative A. It was noted that the slope, on the SE side of Kalanianaole Highway is quite steep and that any significant grading along the highway in this area, as would seem to be required in proposed alternatives A, B, and C may well impact areas outside (downslope) of the archaeological reconnaissance area. As a result an archaeological reconnaissance of an approximately 4-acre parcel on the southeast side of Kalanianaole Highway was arranged for. This research similarly located no prehistoric archaeological sites or cultural layers. The results of this additional parcel reconnaissance are given in Appendix A.

ACKNOWLEDGEMENTS

Fieldwork was conducted by the authors and Mr. Mark Stride. We would like to thank Mr. George Krasnick of Parsons Hawaii for supplying maps and aerial photos of the project area and facilitating our research. We would like to thank Mr. Don Hibbard of the State Historic Sites Section, Department of Land and Natural Resources and Mr. Phillip Rowell of Barton-Aschman Associates for their input in evaluating the aesthetic impact of the various proposed highway alternatives on the Kaneohe Ranch Office Building. Word Processing was by Dr. Vicki Creed.

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I. INTRODUCTION

A. Project Overview

Cultural Surveys Hawaii was asked by Parsons Hawaii to perform an archaeological reconnaissance and background literature survey in association with the proposed Castle Junction Interchange Project. The reconnaissance area (Figs 1-9) consists of about 20-acres in the vicinity of the presently existing Castle Junction. Castle Junction is the intersection of FAP Route 61 (Pali Highway - Kalanianaole Highway), FAP Route 83 (Kamehameha Highway), and Auloa road. From the present day interchange, the project area extends SSW along both sides of the Nu'uanu Pali Highway for a distance of 1800', extends NE up both sides of Kalanianaole Highway for a distance of 1500', and extends NW along both sides of Kamehameha Highway for a distance of 1300'. The width of the reconnaissance corridor on either side of the edge of the highways varies between 400' and 100', being widest near the present interchange and narrowing with distance from the present interchange.

The project area was traversed in pedestrian sweeps by three archaeologists over three days during November and December of 1989. No prehistoric or traditional sites or cultural layers were encountered. A number of curious late historic features (Figs. 15-17) were identified within the project area, SE of the Pali Golf Course Access Road, and are thought to relate to U.S. Army Camp Pali which was located in the immediate vicinity in 1945 (Fig. 12).

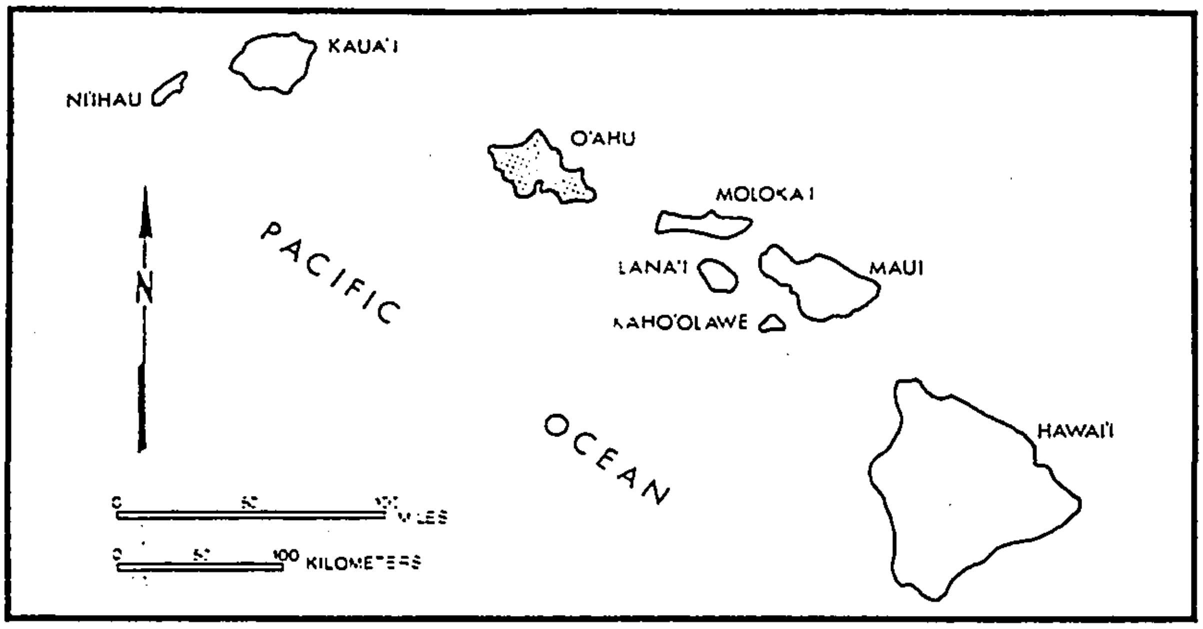


Fig. 1. State of Hawai'i

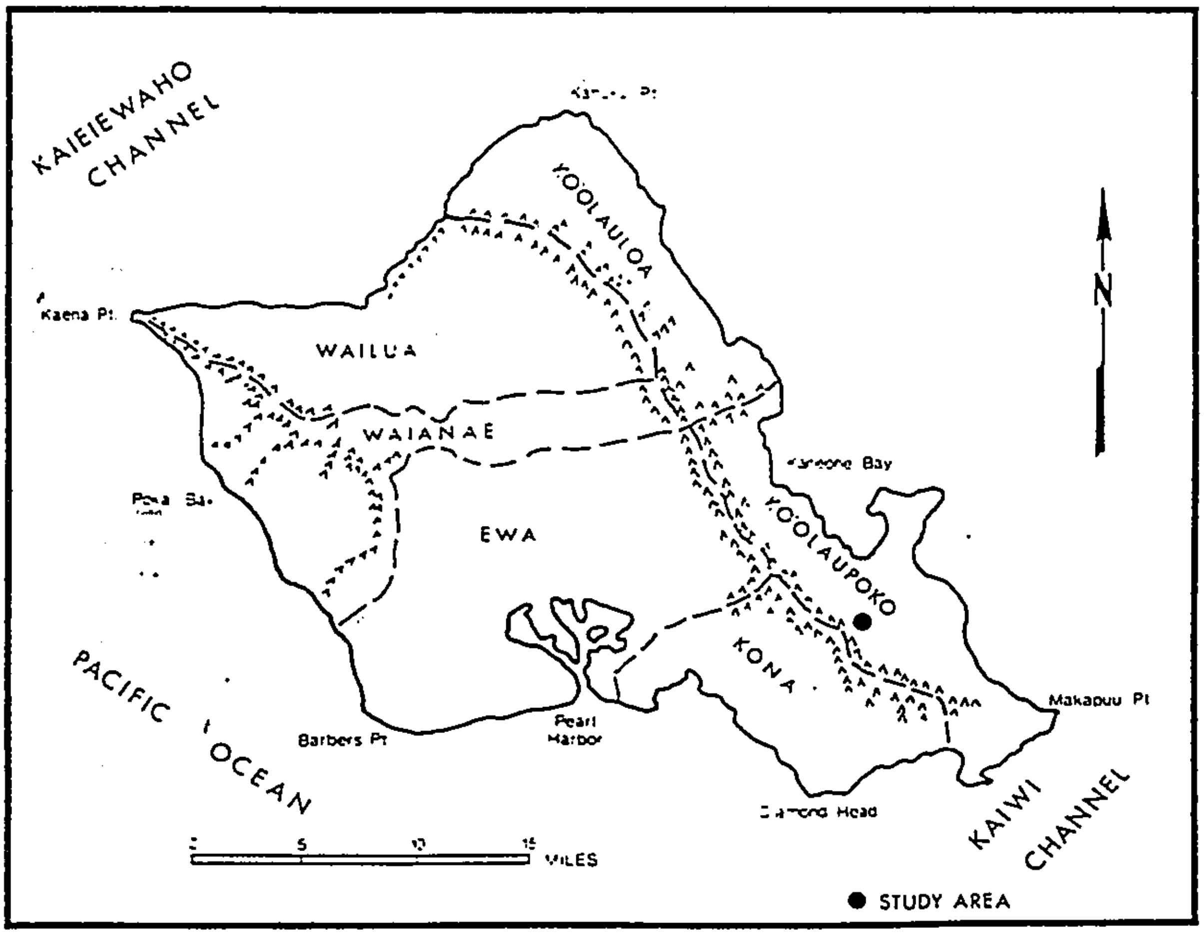


Fig. 2. General Location Map, O'ahu Island.

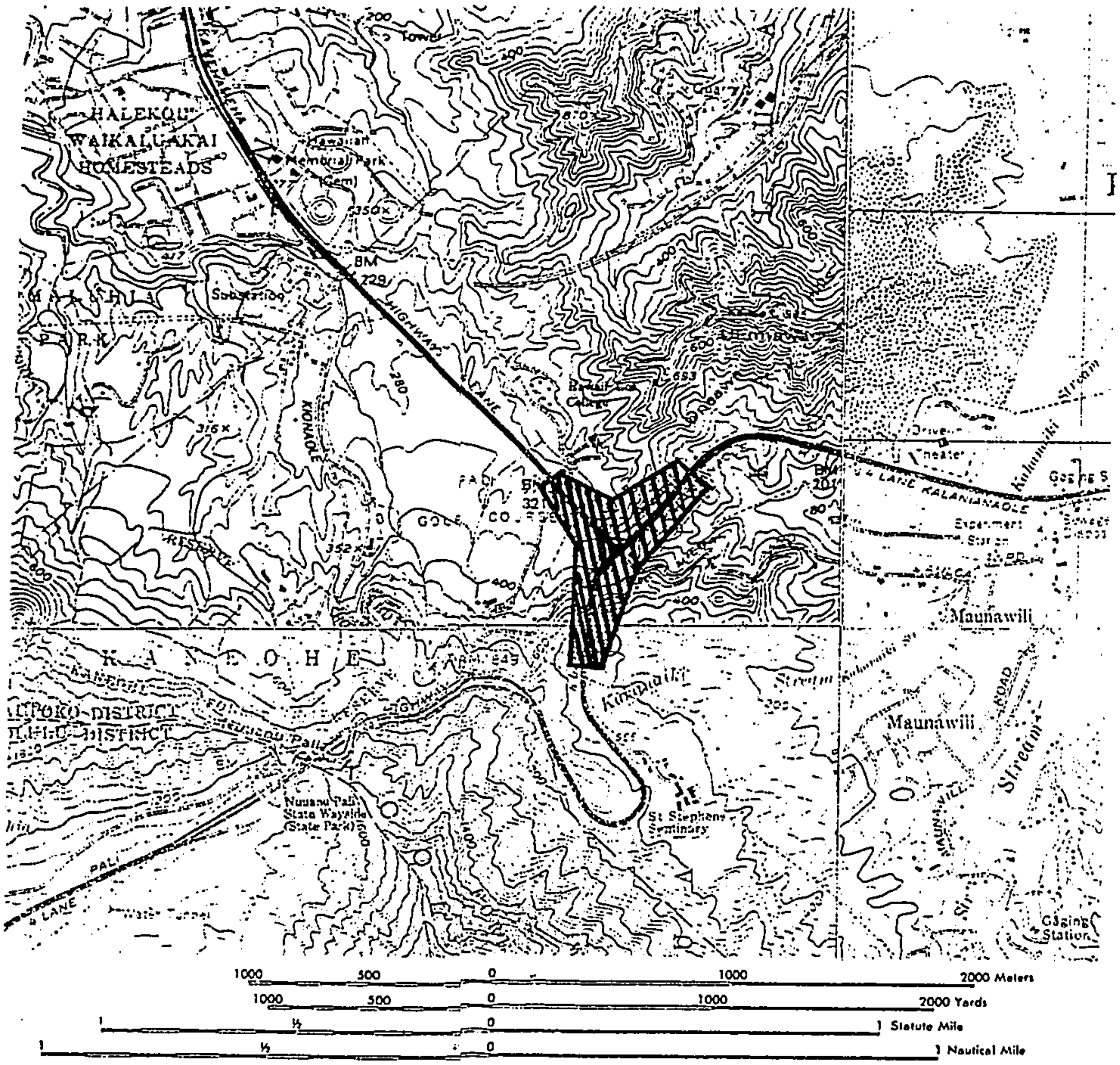


Figure 3 U.S.G.S. Portions of Quad Maps Kane'ohe, Makapu'u, Kokohead, and Honolulu Showing Project Area

Historic and archaeological background research focused on prehistoric land use, particularly the trail system in the vicinity, the history of ranching and pineapple cultivation, and the military history of the area.

B. Project Area Description

The project area, consisting of an approximately 20-acre tripodal-shaped parcel abutting Kamehameha Highway, the Nu'uanu Pali Highway, and Kalanianaole Highway in the vicinity of Castle Junction, has been massively impacted by grading activity associated with the construction of the existing junction. Many thousands of tons of earth were moved, particularly in the immediate vicinity of the junction (Fig. 18) and to the south along Kalanianaole Highway. Much of this earth appears to have been pushed into a deep gully off the east side of Kalanianaole Highway where it rests at a very steep angle. Any lane development on the east side of Kalanianaole Highway as would seem to be required in proposed alternatives A, B, and C would seem to require massive filling that would impact areas downslope and outside of the limits of our archaeological reconnaissance.

The portion of the project area that is not presently maintained as roadways or as lawns of the Kaneohe Ranch Office, War Memorial or Hawaii Loa College tends to be densely wooded. These woods are almost entirely of exotic species. Immediately south of Castle Junction and east of the Pali Highway is an extensive planted forest of Norfolk Pines. The size of these trees is consistent with similar forests planted on O'ahu by the

Civilian Conservation Corps in the 1930s. South of this is an area with many large mango trees and guava forest. there is a steep road cut on much of the west side of the Pali Highway. Vegetation here includes a variety of grasses, _ti_, banyan, christmasberry and _hau_. On the steep slope on the east side of Kalanianaole Highway is a large stand of bamboo and thickets of hala and christmasberry trees with some _ti_, guava, _uluhe_ and vines. A belt of planted ornamental shell ginger parallels the east side of the highway. There is a massive road cut on the west side of Kalanianaole Highway. Vegetation in this area includes thickets of christmasberry, a variety of grasses, areas of dense vines, and stands of guava. Along the margins of Kamehameha Highway are grassy clearings, guava thickets, banyan trees and landscaped areas associates with Hawaii Loa College and the Pali Golf Course.

C. Scope of Work and Methods

The scope of work agreed upon between Cultural Surveys Hawaii and Parsons Hawaii included the following.

1. Fieldwork consisting of an archaeological reconnaissance of approximately 20 acres to locate, map, and describe archaeological sites.
2. Preparation of a report containing the following:
    a. A summary of historical sources and previous archaeological work;

b. Description of all archaeological sites found supplemented with maps and photos and with evaluations and significance assessments;

c. A summary and recommendations for further actions.

Fieldwork consisted of pedestrian sweeps by three archaeologists from Cultural Surveys Hawaii. Particular attention was given to areas of relatively level ground and to areas containing Polynesian cultigens (ti, noni, coconut, hau, hala) and historically introduced cultigens (mango, avocado) which might have indicated the presence of a homesite. Background research was conducted primarily at Hamilton Library, University of Hawaii at Mānoa, the Historic Sites Section DLNR, and the State Survey Office.

II. ARCHAEOLOGICAL AND HISTORICAL BACKGROUND

A. History and Land Use

1. A note on the Southern Boundary of Kailua and Kane'ohe Ahupua'a

There is some confusion over where the southern boundary between the ahupua'a of Kailua and Kane'ohe lies. Kelly and Clark (1980:11) and Shun et al. (1987:33) place the boundary along the west side of a land division known as Kalaheo, about 5,000' NW of Castle Interchange along Kamehameha Highway. This is in error, and at least in the later case may have resulted from confusion between a land division called Kalaheo in Kane'ohe and land divisions called Kalaheo in Kailua. The Wall map (RM 2053) of 1899 (Fig. 6) and the King map of 1900 (Fig. 7) show the boundary division between Kailua and Kane'ohe correctly, as does the foldout map of Ko'olaupoko in Sterling and Summers (1978) (Fig. 4). The lands at the base of the Nu'uanu Pali were famous in song and legend and were always understood as within the ahupua'a of Kane'ohe (Sterling and Summers 1978:220). It is important in understanding the Hawaiian cognition of this area with its strong sexual metaphors to recognize that the land division of Kaulekola "the sexually excited penis" (Pukui et al. 1984:93), through which the Pali Trail passed straight north, lies within Kāne'ohe "bamboo husband" (bowdlerized by Puku'i), and not in Kailua. We understand the Kailua/Kāne'ohe boundary as bisecting Castle Junction following the ridgeline which was largely removed by blasting during the construction of the interchange.

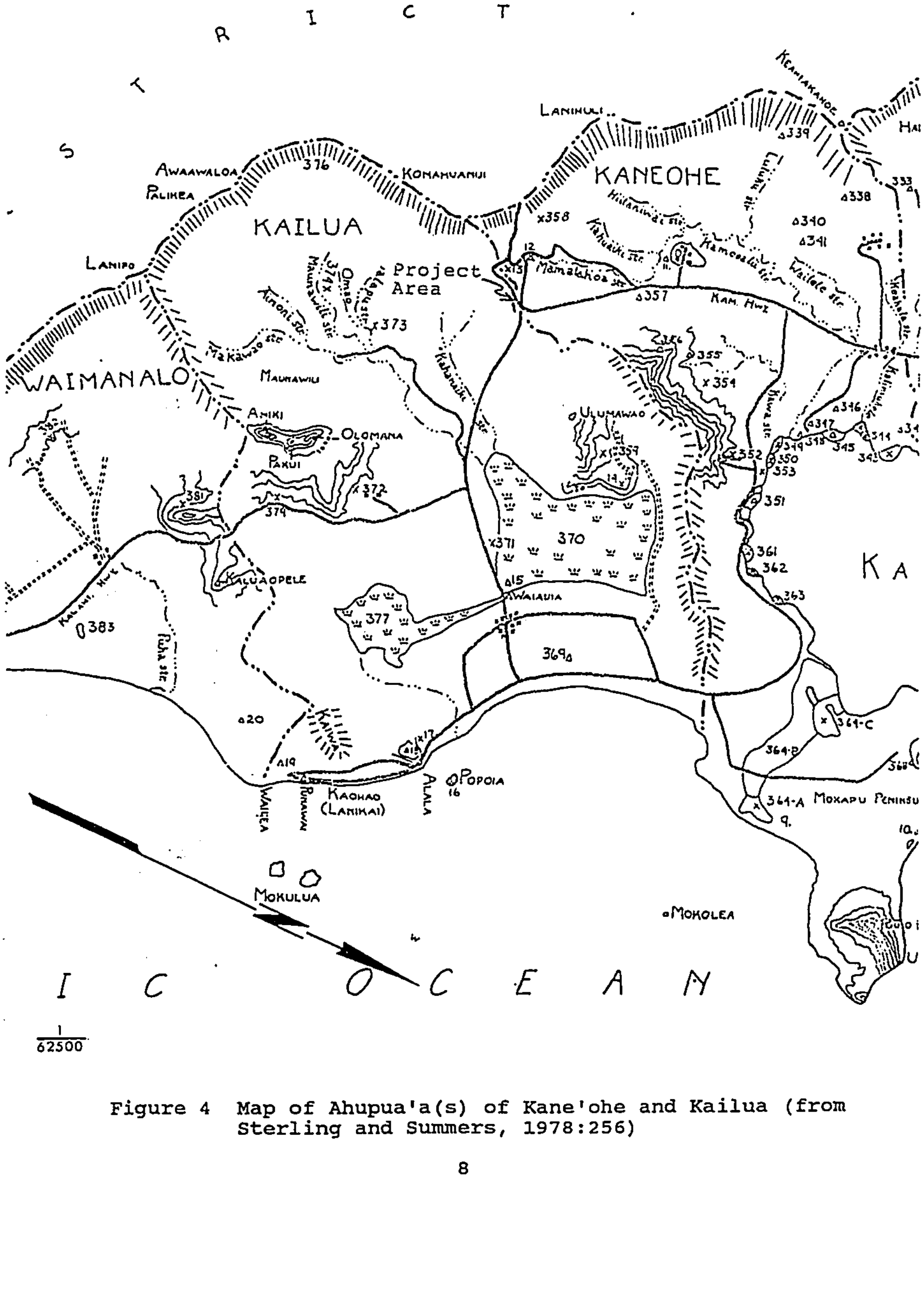


Figure 4 Map of Ahupua'a(s) of Kane'ohe and Kailua (from Sterling and Summers, 1978:256)

2. Traditional Land Use

The project area lies partially within the ahupua'a (traditional land division of Kāne'ohe and partly within the ahupua'a of Kailua (Fig. 4); two of the eleven ahupua'a within the district of Ko'olaupoko, Island of O'ahu. Little is known of traditional land tenure. O'ahu was conquered by the Maui chief Kahekili in 1783 and again by Kamehameha I in 1795, and it was the custom of ruling chiefs to disregard the land allocations of their defeated rivals. In an early account of Kamehameha I's land allocations on O'ahu ('I'i, 1959:69-70), the land divisions of Kāne'ohe and Kailua are not mentioned and thus it has been assumed (e.g. Shun et al., 1987:12) that Kamehameha I retained these lands for himself and his lineage. This seems quite likely, for during the great division (Mahele) of lands between the King and high chiefs in 1848, the ahupua'a of Kailua and Kāne'ohe (Land Court Award 4452) were claimed by Queen Hazalele-poni Kalama Kapakuhaili, wife of Kamehameha III. In the Kuleana Act of 1850 commoners were allowed to receive awards for house lots and for land that they were cultivating at the time, but none were claimed in the immediate vicinity of the project area. Many kuleana were not claimed for a variety of reasons and thus it is not necessarily the case that there were no houselots or cultivated lands in the immediate area.

However, studies in Ko'olaupoko (Chun, 1954; Miyagi, 1963; Kelly and Clark, 1980; and Allen, 1987) indicate that the vast majority of kuleana were located along main streams and lowlands where crops could be easily irrigated with 'auwai (irrigation canals). The present project area would not have been ideal for cultivation. In the following account of the general vicinity in the mid 1840s the lack of occupation in the area is noted,

> ...(From the foot of the Pali). Thence the road passed through a dense coppice of Pandanus trees laden with large fruits and beautiful male flowers in long sheaths. From this coppice we came out into the open fields, which bore only slight traces of habitation and human industry...Along the entire remainder of the road, I suppose a stretch of about 3/4 mile, I discerned only a single hut and a few holes made in the ground for taro... [Billie MS In Sterling and Summers, 1978:205].

In the absence of data on traditional occupation and cultivation in the area it appears that the primary importance of the project area was its association with the trail system of Ko'olaupoko district. In view of this and the fact that the present archaeological study is undertaken in association with proposed transportation route changes a brief review of the history of Ko'olaupoko trails and their relationship to the project area is offered below.

3. History of Ko'olaupoko Trails

The very spectacular line of cliffs that separates the districts of windward O'ahu (Ko'olaupoko and Ko'olauloa) from the crest region of the Ko'olau Range and the districts of central and leeward O'ahu formed a major barrier to human interchange across the island. In ancient Hawai'i there were a number of routes from one side of the Ko'olau Mountains to the other. One could travel by canoe or foot along the coast but this required the use of a seaworthy canoe for several days or several days for the long walk around sparsely populated and dry areas (Makapu'u or less frequently Kahuku). There were a number of trails from the northern windward district of Ko'olauloa across to Waialua or Wai'anae uka (Wahiawa) such as the Laie Trail and old "Castle Trail" alignments, but the central valley was sparsely populated and there was probably not a whole lot of traffic on these more northerly trans-Ko'olau trails. There was far more reason for people to cross from the rich _ahupua'a_ of the southern windward Ko'olaupoko district to and from Ewa and Honolulu (Kona district). In prehistoric times the southern Ko'olau _pali_ was traversed for a number of purposes but mostly for social rather than political, military, or economic reasons. Of course, people traveling for primarily social purposes would typically transport goods. An account of traffic on the Nu'uanu Pali Trail in the late 1820s reports that

> men and women are going up and down with their ordinary burdens on their shoulders or in their arms such as bundles of potatoes and taro, calabashes of poi, fowls, goats and swine (Rev. Reuben Tinker, 1831; in Sterling and Summers, 1978:225).

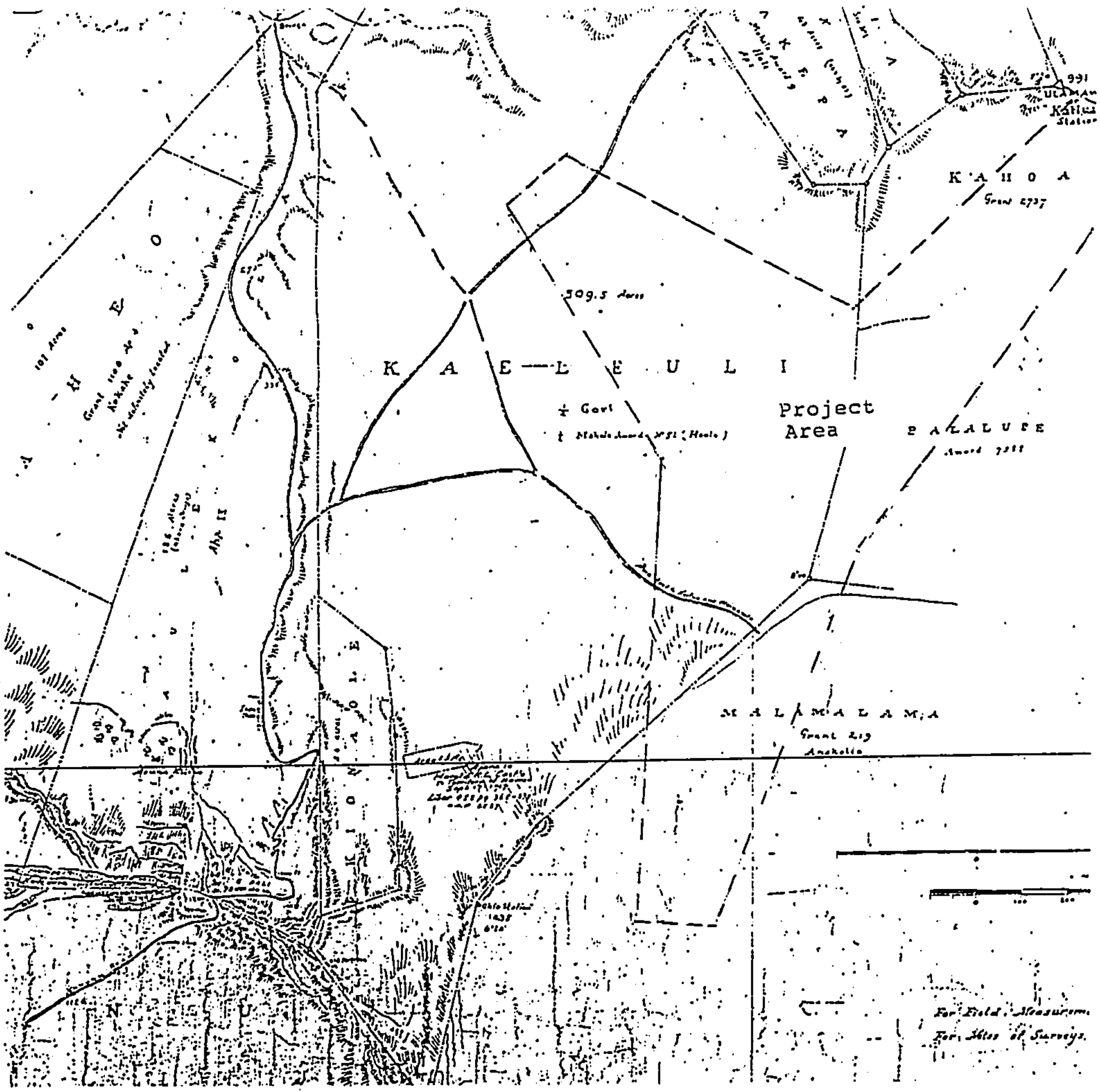
Doubtlessly, most of the goods transported were food stuffs but other utilitarian goods would have been transported as well. 'I'i (1959:30-32) makes references to a boyhood trip (circa 1815) with his father from the family home in Waipi'o in 'Ewa to Kailua in Ko'olaupoko for the purpose of hewing Noni (_Morinda citrifo-_

lia) trees for the red dye used for coloring malo(s). Perhaps significantly they began their trip by canoe but went overland from Nu'uanu up the Nu'uanu Pali Trail.

There were two main routes overland from Ko'olaupoko to Honolulu; one at Kalihi and one at Nu'uanu. The Kalihi pass was more precipitous, requiring the use of ropes and ladders (Byron 1826:140-142, In Sterling and Summers, 1978:225) and the Nu'uanu Pass was preferred in late traditional Hawaiian times.

The Nu'uanu Pali Trail alignment was the main trans-Ko'olau artery until the "old Pali road" was opened in 1897. The old trail alignment (Fig. 5) ascended up the floor of Nu'uanu Valley up to the "nuku of Nu'uanu" or major declivity just west of the present Nu'uanu Pali State Wayside Park overlook. The trail then hugged the windward side of the Ko'olau(s) for about 300 yards till it reached the first major spur to the north at which it "careened down at a breakneck angle" (DeVaney et al. 1982:163). This trail was improved a number of times before construction began on the "old Pali Road" in 1882. The Polynesian trail was first improved by a Boston merchant named Hinckley who blasted portions of the trail in 1830. The Reverend Mr. Beers made an iron handrail and cut steps in 1836. In 1845, funds were set aside to make the trail passable on horseback. This resulted in a widening of the trail to six feet and paving most of it with stone but a span of the trail still had a 49% grade.

The portion of the trail which was cut into the north side of the Nu'uanu Pali was obliterated by later widening of the "old



1" = 500'

Figure 5 Portion of Kaneohe O'ahu with West Kailua Map by C.J. Lyons, 1874 (Registered map 585)

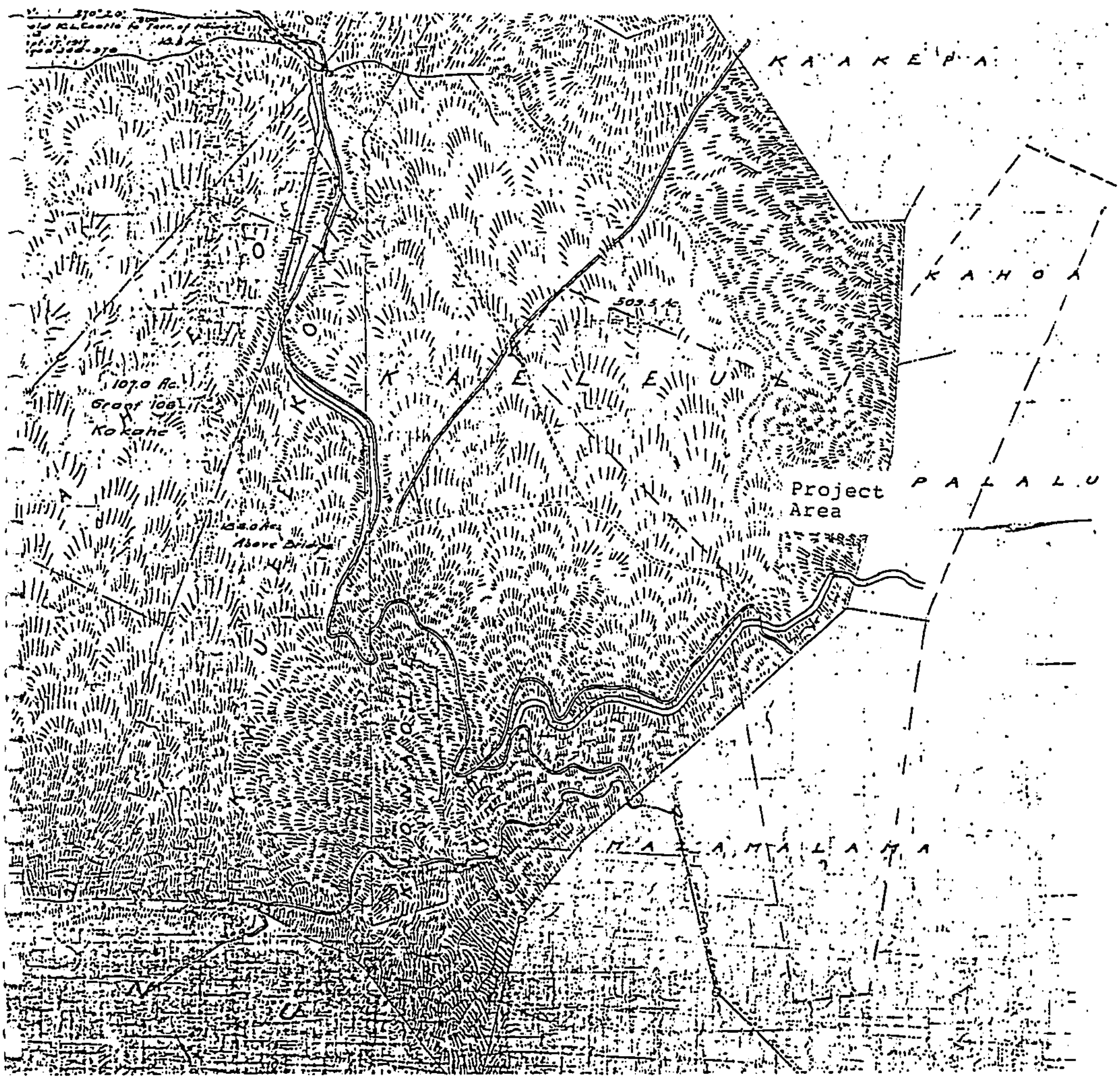


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Figure 6 Portion of map of Kane'ohe, Ko'olaupoko, O'ahu by W.A. Wall, 1899 (Registered Map #2053)

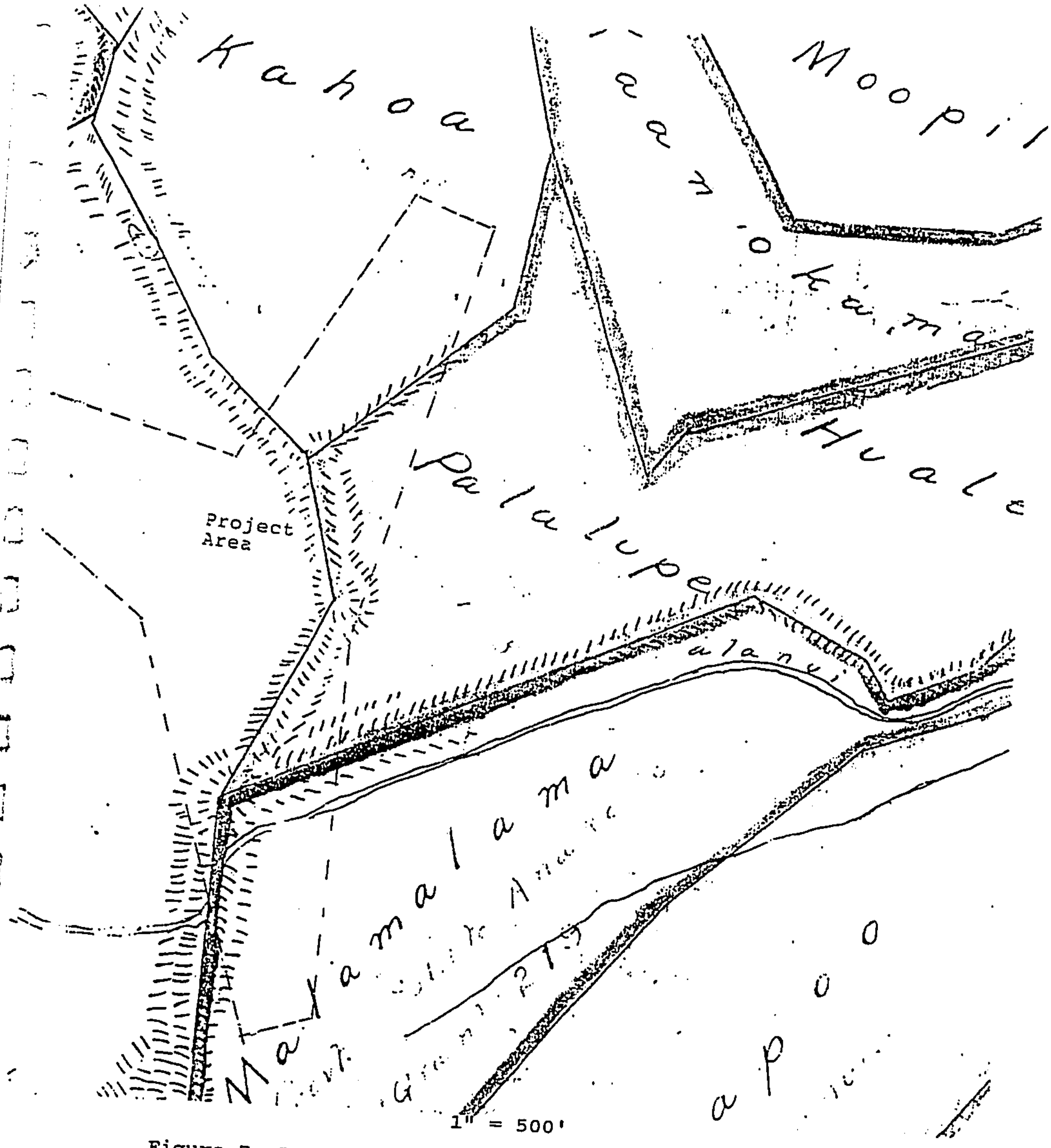

Figure 7 Portion of Map of Kailua, Ko'olaupoko, O'ahu by R.D. King, Aug. 1900 (Registered Map #588)

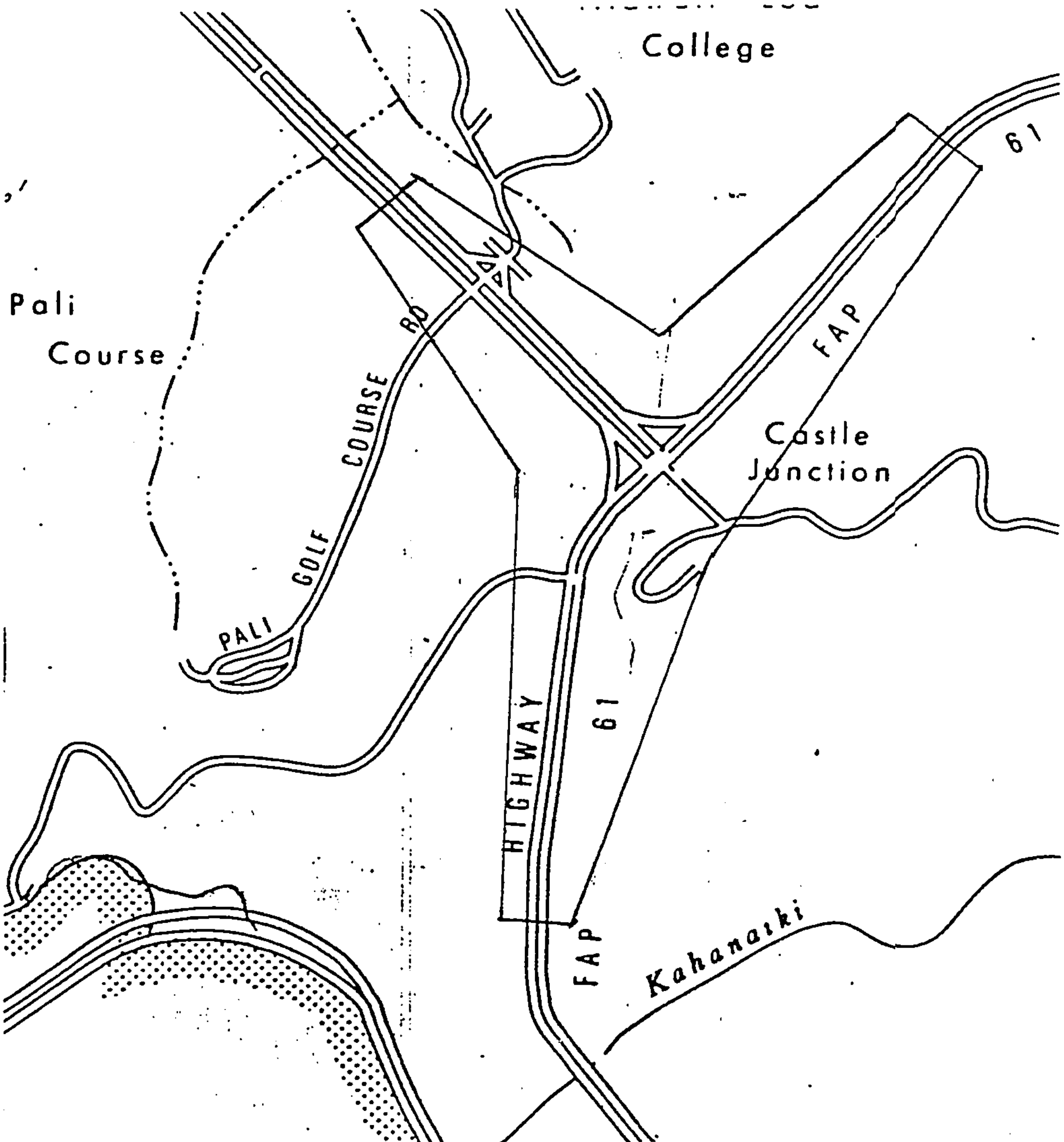

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Figure 8 Portion of Urban Map Kane'ohe, State of Hawaii, D.O.T. Planning Branch, 1981

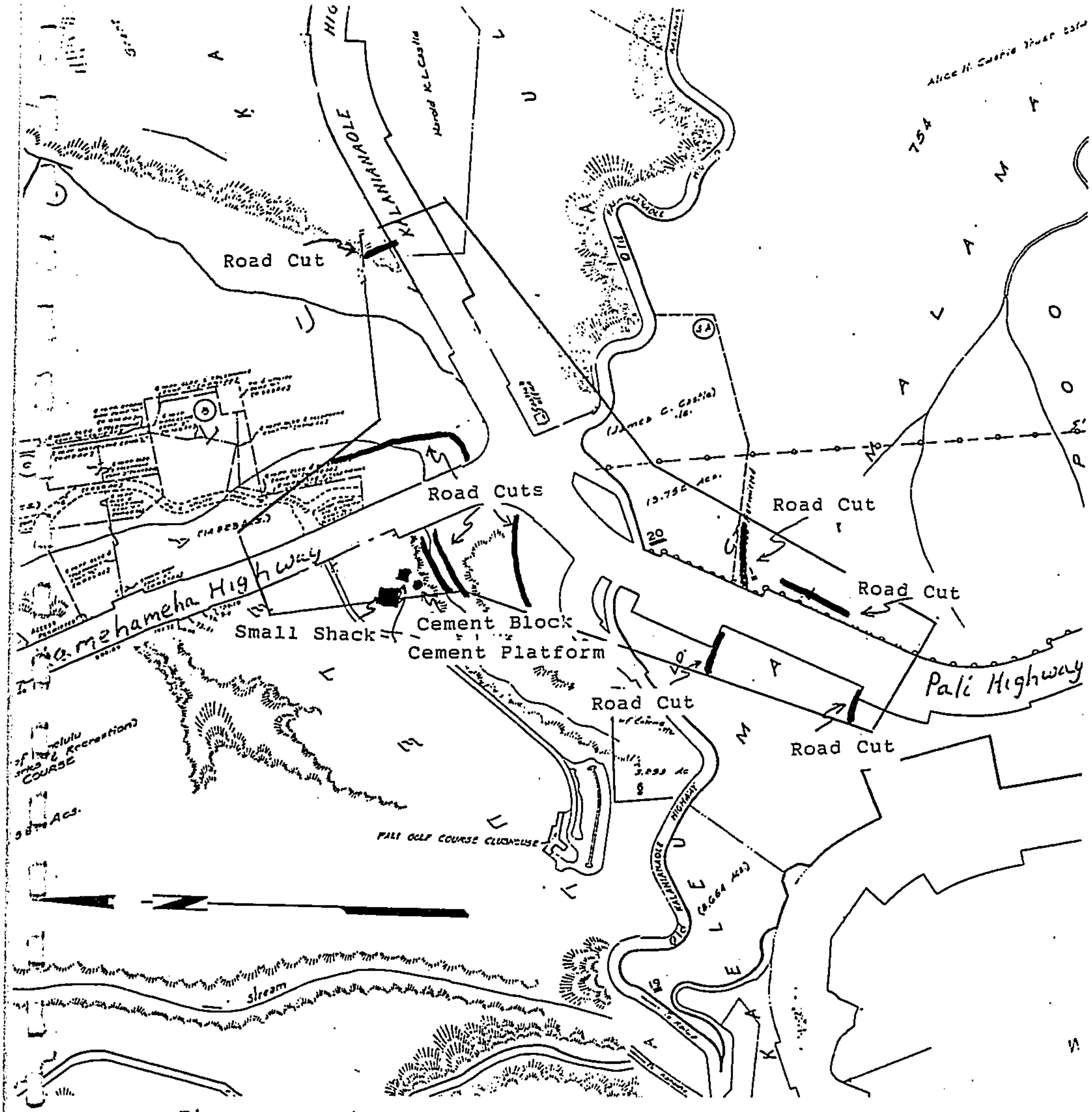

Figure 9 Project Area Showing Location of Existing Roads and Structures

Pali Road." The steep portion of the Pali Trail has virtually disappeared from a hundred years of neglect and erosion. The northern portions appear to have been destroyed by pineapple cultivation in the 1920s and are now largely within golf course developments.

Upon entering Ko'olaupoko district the main branch of the Pali Trail tended pretty much due north (Figs 5 & 6), probably just west of Kahuaiki Stream and roughly parallel to the western portion of KionaOle Road which runs up the east side of Kahuaiki Stream. On the map surveyed by Lyons in 1874 this route is labeled "Approx. Course of Road Honolulu to Makaha" and continues north to the swampy area around the mouths of Kawa and Kāne'ohe Streams. A spur trail branched off to the east crossing Kahuaiki Stream and then branching in two with the NE fork lying roughly along the present H-3 alignment out towards Mokapu Headland, and the east fork tending back toward the south on its way to Waimanalo. This east fork, labelled "Main Road to Kailua and Waimanalo," ran roughly east, just south of the eastern portion of Kamehameha Highway and then continued running roughly parallel to and just north of the north form of Kahanaiki Stream and crossing Kahanaiki Stream just downstream of the confluence of the north and south forks of the Kahanaiki Stream.

Thus, the present project area around the existing Castle Junction was not a particularly important area in the traditional trail system of Ko'olaupoko district. The main Nu'uanu Pali trail descended a spur ridge (Kionaole) to the vicinity of the western portion of Kionaole Road and then roughly followed that alignment north crossing the present Kamehameha Highway about 4,000' NW of the nearest portion of our project area. The main traditional route to Kailua and Waimanalo did cross the present project area, probably just south of where Kionaole Road meets the Pali Highway and just south of the ridge which is south of Auloa Road. What appears to be mechanical road cuts were noted on both sides of the Pali Highway, just south of the Kionaole Road intersection and just south of the existing Castle residence on the east side of the highway, and these are believed to relate to the old route to Kailua and Waimanalo.

4. History of Ranching

The grazing of livestock in the general vicinity of the project area began to have a major impact on the land from about the time Queen Kalama acquired the majority of the ahupua'a(s) of Kailua and Kāne'ohe in 1848. Chiefs and foreigners allowed their cattle to roam freely and these semi-wild herds had a deleterious effect upon both agricultural fields and native forests.

> These herds are allowed to increase altogether beyond the capacity of the lands leased by the owners for pasturing them. Potato fields are destroyed kalo grounds trodden up and very much mischief done in other ways. The result at the present time is, that 100 or more acres of choice land for tillage is now given up and the people plant neither corn, beans, potatoes, or anything of the kind to any extent lest they be destroyed by the cattle.
>
> These cattle, by which the agricultural interests of this whole district are entirely prostrated, are on the whole, the greatest evil from which we are now suffering as a

> people (Wyllie, 1848:69 In Devaney et al., 1982: 11, 12).

A year or two earlier, the Dane Steen Billie noted that "Below the mountains a large herd of cattle belonging to a native magnate Pikuiha was grazing" (Billie MS:126 In Devaney et al., 1982:70).

In 1848, the missionary Parker noted the presence in Ko'olaupoko district of "probably about 600 horned cattle, only a few sheep," but "numerous" goats and also noted that the animals were rapidly increasing in number (Wyllie 1848:2223 In Devaney et al., 1982:70).

The native forest at the foot of the <u>pali</u> was decimated. A visitor reported that the view of Kane'ohe from the <u>pali</u> showed "hundreds of cattle...feeding on the rich pasture with which these plains are covered" (Bates, 1854:104 In Devaney et al., 1982:70).

The pandanus coppice which Billie referred to and which was proverbial in old songs and traditions for its fragrance was rapidly disappearing under the onslaught of grazing animals. By 1866, this land of Kekele, at the foot of Nu'uanu Pali was spoken of thus "It was a rich land a while ago but now there are not many plants because animals are permitted there" (Pualewa, 1866 In Sterling and Summers, 1978:221).

By the 1880s the forest was largely a memory:

> Kekele. "The marsh." The undulating plains in Kane'ohe at the foot of the Nu'uanu Pali. It was a few years ago entirely covered with hala trees and the fragrance from the blossoms or ripe nuts of these trees scented the

> whole plains...(Dictionary of Hawaiian Localities, Saturday Press Oct. 6, 1883 In Sterling and Summers, 1978:221).

While there were many ranching interests in Ko'olaupoko, the largest was Kane'ohe Ranch, the main office of which is just east of the existing Castle Junction. It absorbed most of the lands belonging to Queen Kalama. It is said that Judge C.C. Harris in a transaction "consummated March 24, 1876...he bought the districts of Kane'ohe and Kailua for the sum of $750.00" (Fiddler Ms. 7 In Devaney et al., 1982:72). The property passed to his daughter Mrs. Nanny R. Rice around 1890 and was purchased by Harold K. Castle in 1917. While Kane'ohe Ranch carried 2,000 head of cattle, by the late 1920s this herd had been reduced to 500 head. (Henke, 1929:62-63 In Devaney, 1982:72). Mr. Frazier (personal communication) related that Horn Fly was a major discouragement to cattle ranching at the Maunawili Ranch around the turn of the century and this may have been a factor in decreasing the size of the Kane'ohe Ranch herd. The result of extensive cattle grazing followed by decreasing herd size was that the native forest was "partly gone and replaced to a small extent by Hilo grass and guava" (Hawaiian For. & Ag. 1918:195-6) In Devaney et al., 1982:73). This new guava forest was soon to yield to a new agricultural enterprise as related in the following cyclists' account:

> (from the foot of the pali) "looked out over the surrounding hills, but looked in vain for the great areas of guava through which but a few months ago we had fought and cut our way. As far as the eye could reach pineapple plantations had taken the place of the forests of

wild guava (Mid Pacific, Vol. VIII No. 4, Oct. 1914:318).

5. History of Pineapple Cultivation

PIneapple cultivation flourished in Ko'olaupoko district from 1910 - 1925. In 1912 the Kane'ohe Ranch and He'eia Agriculture Co. agreed to lease 1,000 acres to Libby, McNeill, and Libby in He'eia, Kane'ohe and Kailua. A considerable amount of land was subleased to growers through 1920. About 1920, Mr. Herman Russell operated a small cannery in competition with the large Libby cannery at He'eia and the resulting competition for pineapples encouraged production. Photographs of pineapple fields in the early 1920s (Figs 10 & 11) clearly show the cultivation of pineapple within the western portion of the project area. It seems probable that as Kailua lands are specifically referred to in the 1912 lease that pineapples were grown on the saddle where the existing Castle junction is now located. With the collapse of commercial pineapple cultivation on the windward side most of the pineland became pasture or scrub forest. Cattle were probably pastured in the project area through much of the twentieth century.

6. Army Occupation

Unfortunately, during WWII a minimum of records were kept of army activities in Hawaii and military personnel and civilians were strongly discouraged from recording their observations about military efforts. One of the fifty Army bases on O'ahu during WWII was "Camp Pali" which was located partially within the

Figure 10 Pineapple Fields in Southern Kane'ohe in NW Portion of Project Area, View to NE

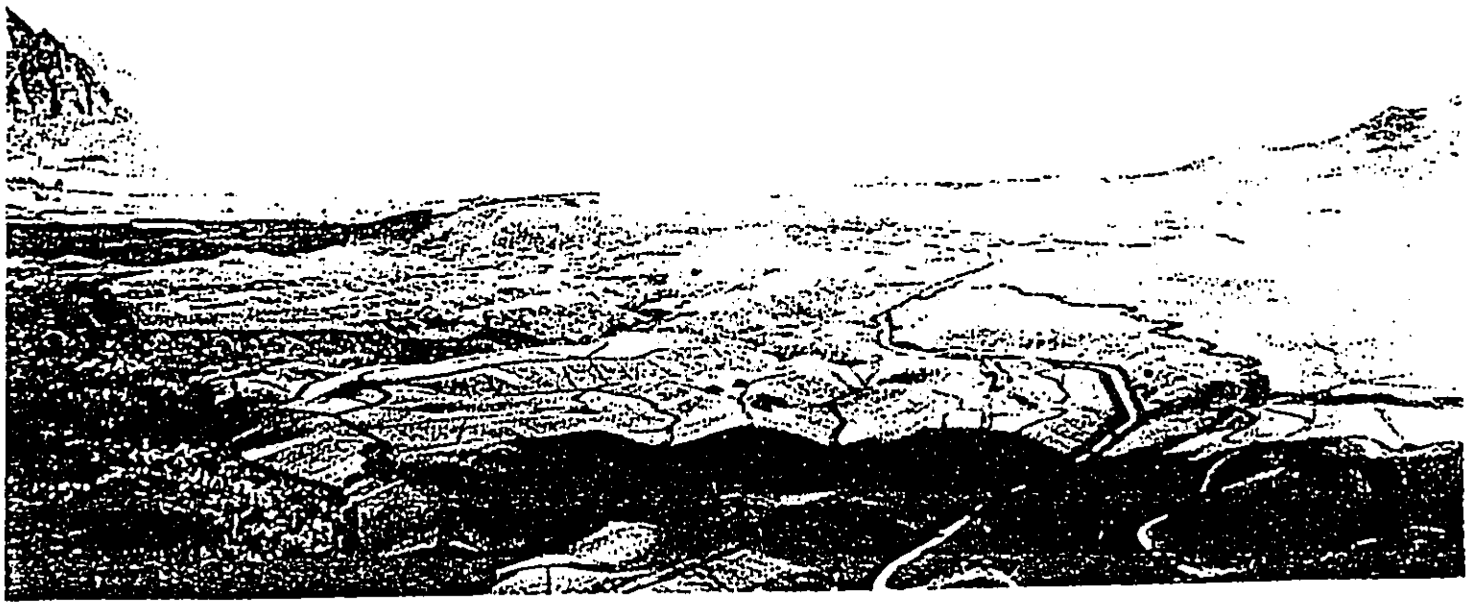

Figure 11 Pineapple Fields in Southern Kane'ohe just NW of Project Area at height of Pineapple Cultivation, circa 1920. View to NW (<u>Paradise of the Pacific</u>, Jan. 1924)

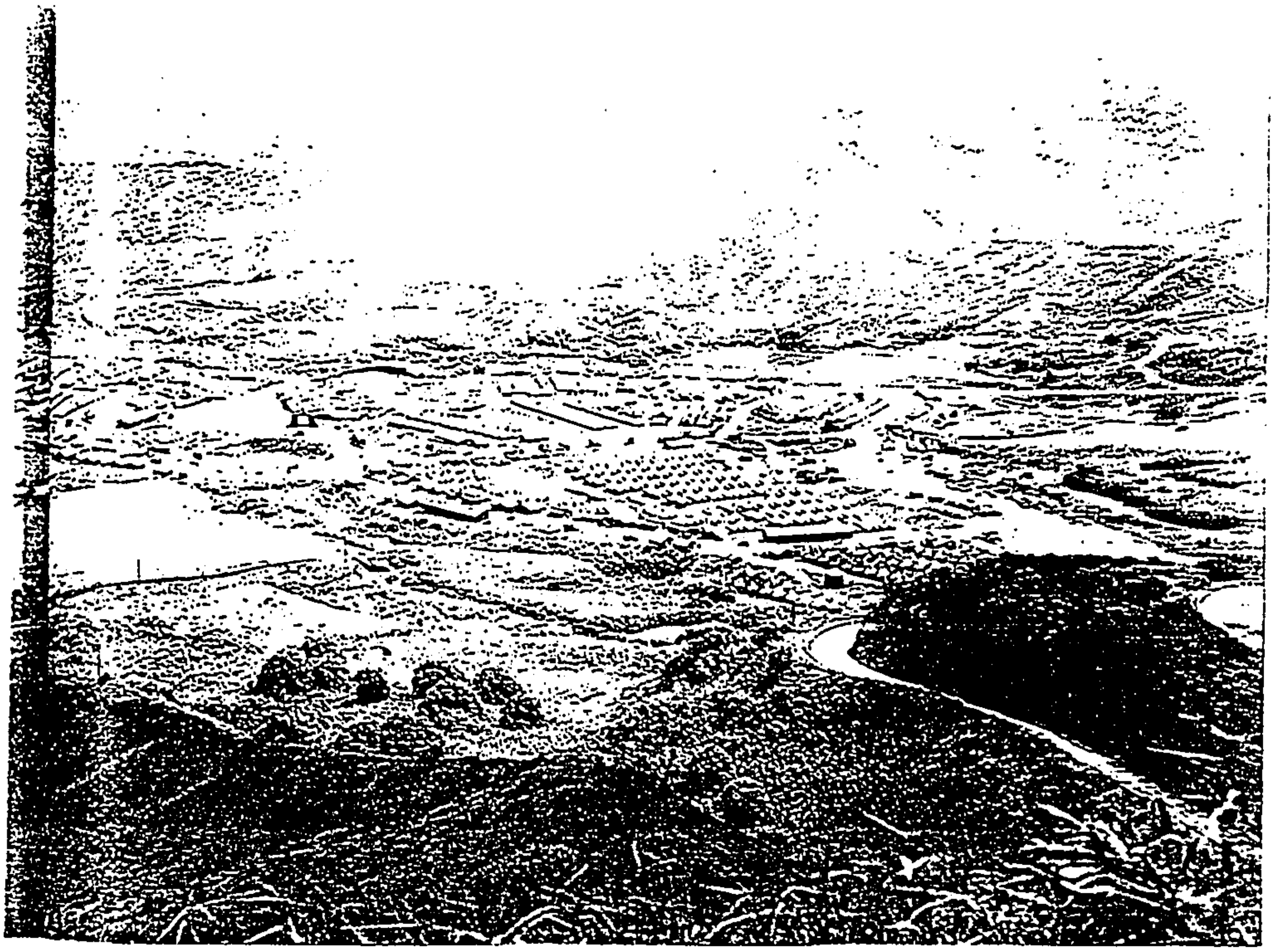

Figure 12 Camp Pali in the NW Portion of the Project Area, August 1945. View to North. "From the top of the Pali this vast stretch so neatly arranged looked like a toy city..." (Hawaii Goes to War, 1989:123)

present study area. About this Army camp we know virtually nothing other than what can be gleaned from a single photo (Fig. 12); its caption "From the top of the Pali this vast stretch so neatly arranged looked like a toy city," and a few odd artifacts remaining on the land (Figs. 15-17). Most of Camp Pali was just west of the project area. However, as it appears that there were well over 1000 soldiers stationed at Camp Pali it would be expected that they would have impacted the immediately surrounding area, including the western portion of the present study area. The head of Hawaii Loa facilities management, Mr. Sagato stated that during the construction of Hawaii Loa many artillery shells and fifty caliber bullets were encountered.

B. Previous Archaeology

The Upland portions of the ahupua'a(s) of Kailua and Kane'ohe have received a good deal of archaeological attention in the last fifteen years. Archaeological research has been associated with the Kane'ohe-Kailua Flood Control project (Rosendahl Ed., 1976), with the development of the H-3 Highway (Cleghorn and Rogers-Jourdane, 1976; Dye, 1977; Streck, 1982; Allen-Wheeler, 1984, 1985; Neller, 1985; and Wheeler, 1987), with proposed developments in Kawainui Marsh (Cordy, 1977; Ewart and Tuggle, 1977; Kelly and Clark, 1980; Kraft, 1980a, b; Kelly and Nakamura, 1981; Allen-Wheeler, 1981; Athens, 1983; Morganstein,, n.d.), with the golf course development (Shun et al., 1987), with the development of two cemeteries (Szabian and Landrum, 1989; Hammatt and Shideler, 1989a) and with the development of a reservoir at Luluku (Hammatt and Shideler, 1989b). As Shun et al., (1987:7) point out "All of these investigations...amount to almost continuous systematic archaeological coverage for the upper portion of Kane'ohe _ahupua'a_." Probably the best attempt to date to synthesize data on the Ko'olaupoko district is in Wheeler's _Five Upland 'Ili_ (1987:252 ff). She concludes that her work at Site G5-85 documents intensive use of an inland area in a core valley of Kane'ohe by A.D. 1400, a period posited for the development of a formative state system. Elsewhere (1987:179), she asserts that in downslope terraces (Features 30 o 38 of Site G5-85) "pondfield agriculture spanned the 5th through 16th or 17th centuries at a minimum.." The significance of this research to the present project is in the suggestion that the "Main Road to Kailua and Waimanalo," which branches off of the Nu'uanu Pali Trail and passed through the _mauka_ portion of the project area, would have been utilized by the time agriculture had expanded to the degree that Wheeler documents. It was noted that the archaeological research in a neighboring 200-acre proposed golf course parcel (Shun et al., 1987:34ff) located only four small sites of which at least two are probably historic. This probably reflects both the relative lack of human enterprise in the area which Billie Steen noted in the mid-1840s and the massive impact of ranching, pineapple cultivation, the U.S. Army and golf course development, which would have destroyed much of what little archaeology might have existed in the vicinity.

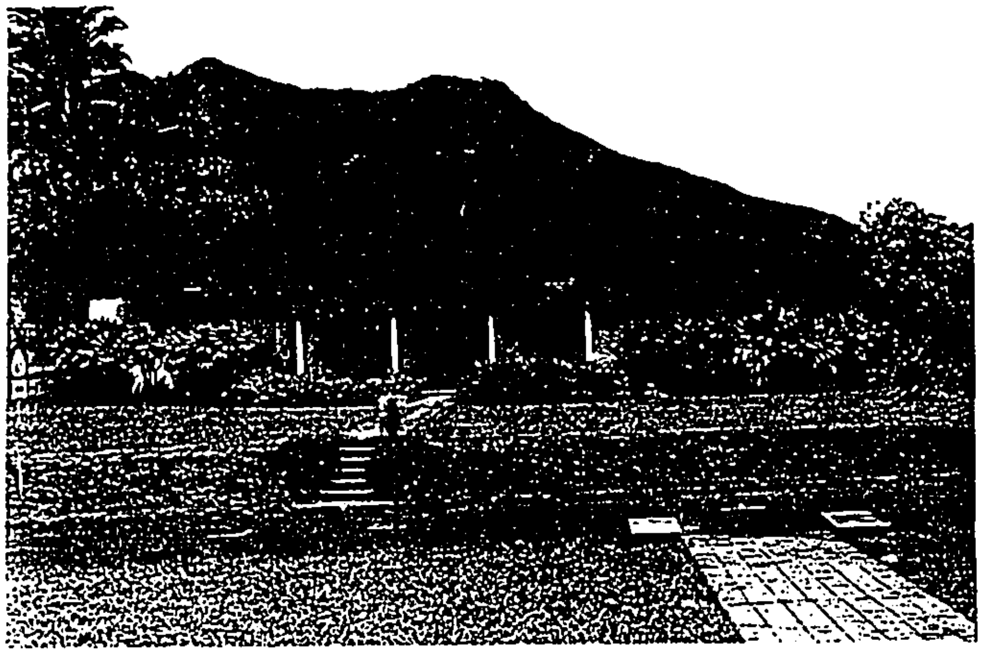

Figure 13 Kane'ohe Ranch Business Office

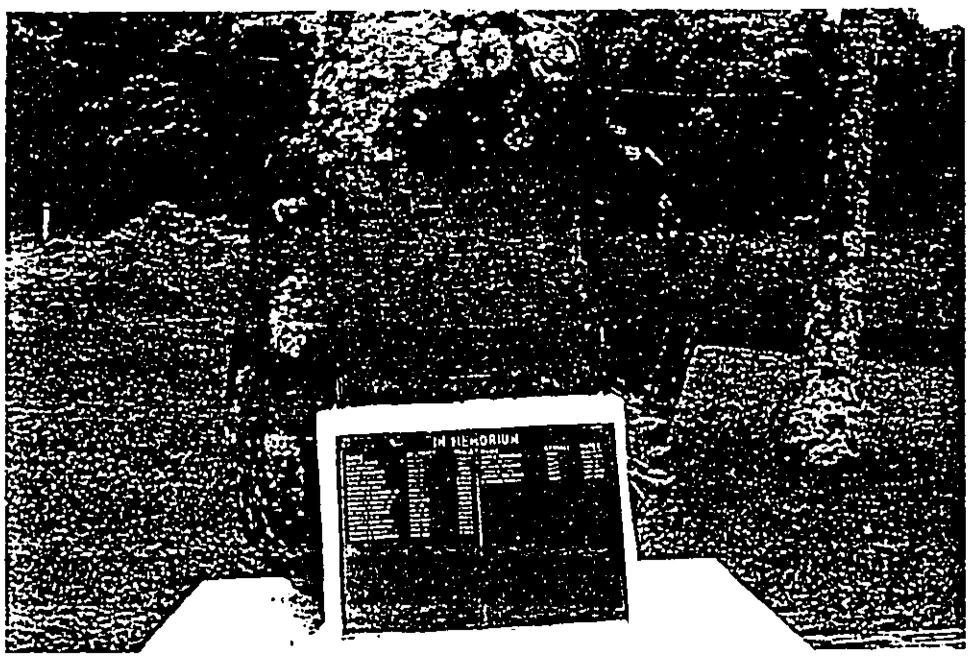

Figure 14 War Memorial Boulder and Plaques

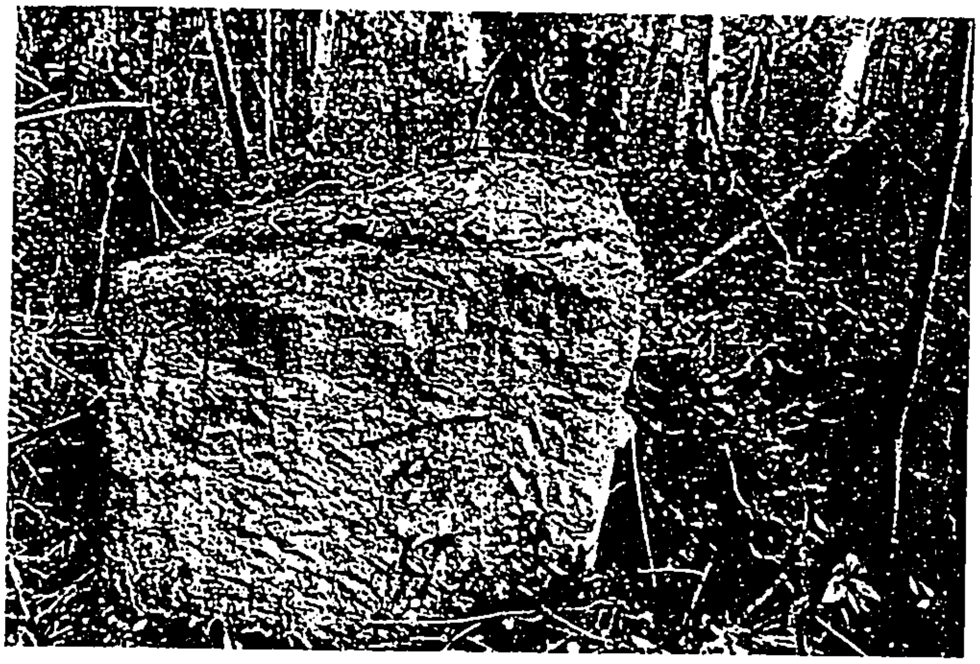

Figure 15 Cement Block Located SE of the Pali Golf Course Access road

Figure 16 Cement Platform Located SE of the Pali Golf Course Access Road

Figure 17 Remains of a WWII Era Wooden Structure Located SE of Pali Golf Course Access Road

Figure 18 View of North Portion of Existing Castle Junction, Showing Extent of Road Cut

III. SURVEY RESULTS

No prehistoric archaeological sites or cultural layers were encountered. No historic sites of any significance were observed other than the Kane'ohe Ranch Office and the War Memorial Boulder (Figs 13 & 14). Our findings are detailed below.

Along the southeast side of the Pali Highway two road cuts were observed. The more pronounced lies about 800' southwest of Castle Junction, just west of the large single family dwelling (Castle residence). Aerial photos show this road cut running roughly parallel to Auloa Road (old Kalanianaole Highway) along the south side of the ridge which separates it from Auloa Road. This road cut is clearly visible on the northwest side of the Pali Highway about 400' southwest of the Kionaole Road (old Kalanianaole Highway) turnoff. Another fainter old road alignment was observed paralleling the Pali Highway on the downslope (southwest side) in the area southeast of the runaway truck ramp. Many large boulders were noted in this area which were probably pushed off the Pali Highway during construction. In this area there is good level land, which appears to have not been previously impacted by grading or bulldozing, but there were no sites.

Along the northwest side of the Pali Highway the land rises steeply and much of the project area here is road cut for the highway. In addition to the road cut about 400' southwest of Kionaole Road already noted, a second road cut was observed near the westernmost corner of the project area between the large banyan tree and the hau thicket.

Along the west side of Kamehameha Highway, between Kionaole Road and the Pali Golf Course Access Road, a number of historic land modifications were noted. In a grassy area about 500' northwest of Castle Junction a minimum of three bulldozed road alignments were noted. These appear to originate from the vicinity of the first bend of Kionaole Road, about 300' up the road from the Pali Highway, and fan out towards the south portion of Kamehameha Highway. Just north of these road cuts, about two hundred feet west of Kamehameha Highway and 350' south of the Pali Golf Course access road, three late historic structures were noted. The first encountered (Fig. 15) is a 4' by 5' by 5' high block of angular road gravel and cement with a somewhat mounded top, with rebar sticking out of it and a pipe running obliquely through the basal portion. This object appears to weigh a couple of tons. The poor construction and the lack of any obvious purpose suggests a military origin. This may have served an anchoring function or may simply have been created in the process of disposing of concrete and gravel. In this vicinity is a low concrete and cinderblock platform (Fig. 16) measuring about 8' by 8' square and 1' high. No obvious purpose for this platform could be determined. Curiously, there were the remains of what appeared to be potted plants (rootballs and soil) on the concrete surface of the platform. They did not appear to have resulted from illicit marijuana cultivation, but to have been house plants. An old vacuum cleaner was observed in the vicinity but no other historic debris was observed in the area. To the northwest about 100', on the west boundary of this portion of the project area, are the remains of a small shack (Fig. 17). This too proved enigmatic. The presence of what appears to be a large quantity of crude salt in the shack suggested a ranching function. A large diameter water pipe valve and remnants of electrification were observed. The area just to the north of the shack was clearly graded at one time and is now mostly in grasses. The northern portion of the project area all appears to have been graded.

Along the east side of Kamehameha Highway there has been extensive grading. While much of this grading may have been associated with the construction of Hawaii Loa College in the late 1960s, much of the grading appears to be older. A major road cut runs from the vicinity of the junction to the east for a short distance and then ascends steeply, roughly parallel to Kamehameha Highway. The date and purpose of this road is unclear.

Massive road cuts cover much of the north side of Kalanianaole Highway. Along the ridgeline there are traces of barbed wire fencing which is presumed to date to WWII. Near the eastern end of the project area on the north side of the highway is another bulldozed road running perpendicular from the highway to the north.

The south side of Kalanianaole Highway is on the steep side of a gully and appears to have been massively impacted by sediment pushed down during road construction. Nothing of interest was noted in this area other than an old safe (open, empty) just east of the Kane'ohe Ranch office.

It may be noted that during the course of archaeological reconnaissance a number of peculiar vignettes of human utilization of the vicinity were noted. Just northwest of the intersection of the Pali Highway and Kionaole Road a young couple was noted scrambling up the steep hillside. No forest resources were observed in this area and their purpose is unknown. Just west of the southern portion of Kamehameha Highway a man was observed walking his goat. Why he was walking his goat there is unknown. Northeast of Castle Junction and just northeast of the interior angle of the project area (hence just outside of the project area) two curious excavations about 3' by 6' by 2' deep were noted on a steep slope. Their purpose is unknown. About 400' from these excavations and just outside the project area, a rather elaborate, long-term camp (squatter camp?) was observed. This encampment was notable for the number of captive ducks and hundreds of glass jars present.

IV. SUMMARY AND RECOMMENDATIONS

An archaeological reconnaissance of the project area revealed no prehistoric sites or cultural layers and no significant historic sites other than the Kane'ohe Ranch Office and War Memorial Boulder.

Background research shows that the area was massively impacted by ranching, pineapple cultivation, and the stationing of at least 1000 soldiers at Camp Pali (in 1945) which included the north portion of the project area. While the massive cement block, cement platform, and shack in this vicinity are still somewhat enigmatic they are thought to most probably relate to the period of army occupation.

The greatest impact to the project area has, of course, been associated with road construction. In February of 1952 work was begun to eliminate the hairpin turn on the Old Pali Highway and a new four-lane highway was built from the turn to the Kane'ohe Ranch office. This construction was probably the cause of the massive earth moving within the project area.

Evidence from historical sources, particularly the account of Steen Billie circa 1845, and from neighboring archaeological studies, particularly Shun et al. (1987), suggest that there was probably little traditional Hawaiian utilization of this immediate area. The old Pali Trail ran considerably to the north of Castle Junction. An old trail to Kailua and Waimanalo (the Alanui) ran through the southern portion of the project area but no trace of this trail could be discerned. It appears that this trail (cf. Figs 7 & 9) ran through the 'ili (land division) of Malamalama, just south of Auloa Road which runs through the land division of Palalupe.

The State Department of Land and Natural Resources (DLNR) has determined that the War Memorial Boulder is not a historic site and/or a State Park covered by provisions of Section 4(f) of the Department of Transportation (DOT) Act. We understand that the three alternatives under consideration may require the relocation of the War Memorial. We urge that if the War Memorial is to be moved that proper consideration be made for its relocation and rededication and that there be consideration of a third plaque dedicated to those men of windward O'ahu who were killed in action in later conflicts (Vietnam through Panama). The Kane'ohe Veterans Cemetery would be a fitting place for relocation.

The Kane'ohe Ranch Building was placed on the State and National Registers of Historic Places in 1983 as Site number 80-10-1360. Built in 1941 it has received international awards. Special attention should be directed toward maintaining not only the structure, but also the integrity of its immediate surroundings. A meeting of concerned individuals from Parsons Hawaii, Barton-Aschman Associates, the State Department of Transportation and Cultural Surveys Hawaii was held on 3/22/1990 with Don Hibbard, State Historic Preservation Officer in order to solicit his opinion of the aesthetic impact of the various proposed alternatives on the Kaneohe Ranch Office Building. It was his conclusion that Alternative A - which features a large looping underpass on the makai side (NNE) - would have no adverse effect on the historic site. Mr. Hibbard concluded that alternatives B and C would have an adverse effect based on obstruction of view. The selection of either Alterative B or C would thus seem to require going through the "106 process." This basically requires a federal historic preservation advisory committee (in Washington) to review the proposed impact and to make recommendations for mitigation. It would appear that nothing could be done to mitigate the adverse impact of Alternatives B and C. Thus, the choice of Alternatives B and C could be highly problematic and would involve extensive delays. In accordance with Mr. Hibbard's views, we recommend adoption of Alternative A.

No further archaeological investigation or monitoring within the project area is recommended. However, if there is to be significant construction on the south side of Kalanianaole Highway, as would seem to be required under alternatives A, B, and C, it seems probable that the steepness of the slope would cause any fill material to impact areas outside of our archaeological project area. All three configurations would require massive engineering on the steep slope on the southeast side of Kalanianaole Highway. In the unlikely event that cultural remains of any kind especially human burials, are encountered during construction an archaeologist and the State Historic Preservation Office should be contacted immediately before earth moving in the vicinity is resumed. The presence of unexploded ordinance on the grounds of Hawaii Loa College dating to the occupation of Camp Pali has been noted. While no ordinance was observed, the possibility exists that some will be encountered in the vicinity in the future.

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Appendix A: Report on the Archaeological Reconnaissance of An Additional Four-acre Parcel

Upon being supplied with maps of the proposed alternatives for the Castle Junction Interchange project it became immediately clear that all three of the proposed plans impacted an area outside of the original archaeological project area. Consultation between Parsons Hawaii and Cultural Surveys Hawaii led to an agreement for an archaeological reconnaissance of an additional parcel of land totalling about 4 acres located on the southeast side of Kalanianaole Highway (Fig. 19).

This additional wedge-shaped area for archaeological reconnaissance abuts the downslope (SE) edge of our previous survey corridor on the SE side of Kalanianaole Highway for a distance of about 1070'. The maximum width of this additional survey area is 270' but it tapers to a point at both the SW and NE ends.

This additional project area includes the heads of two small gulches which drain into Kahanaiki Stream and is generally quite steep. The area is bisected by a powerline and powerline road but the roadway is quite overgrown and is impassible.

Vegetation is quite diverse and included native ohia trees (*Metrosideros collina*) and planted paperback trees (*Melaleuca leucadrendra*) and Silver Oak (*Grevillea robusta*) in that portion closest to Auloa road and thickets of Christmasberry (*Schinus terebinthifolius*), Octopus Tree (*Brassaia actinophylla*), Java Plum (*Eugenia javanica*), Cats-claw (*Caesalpinia decapetala*), and

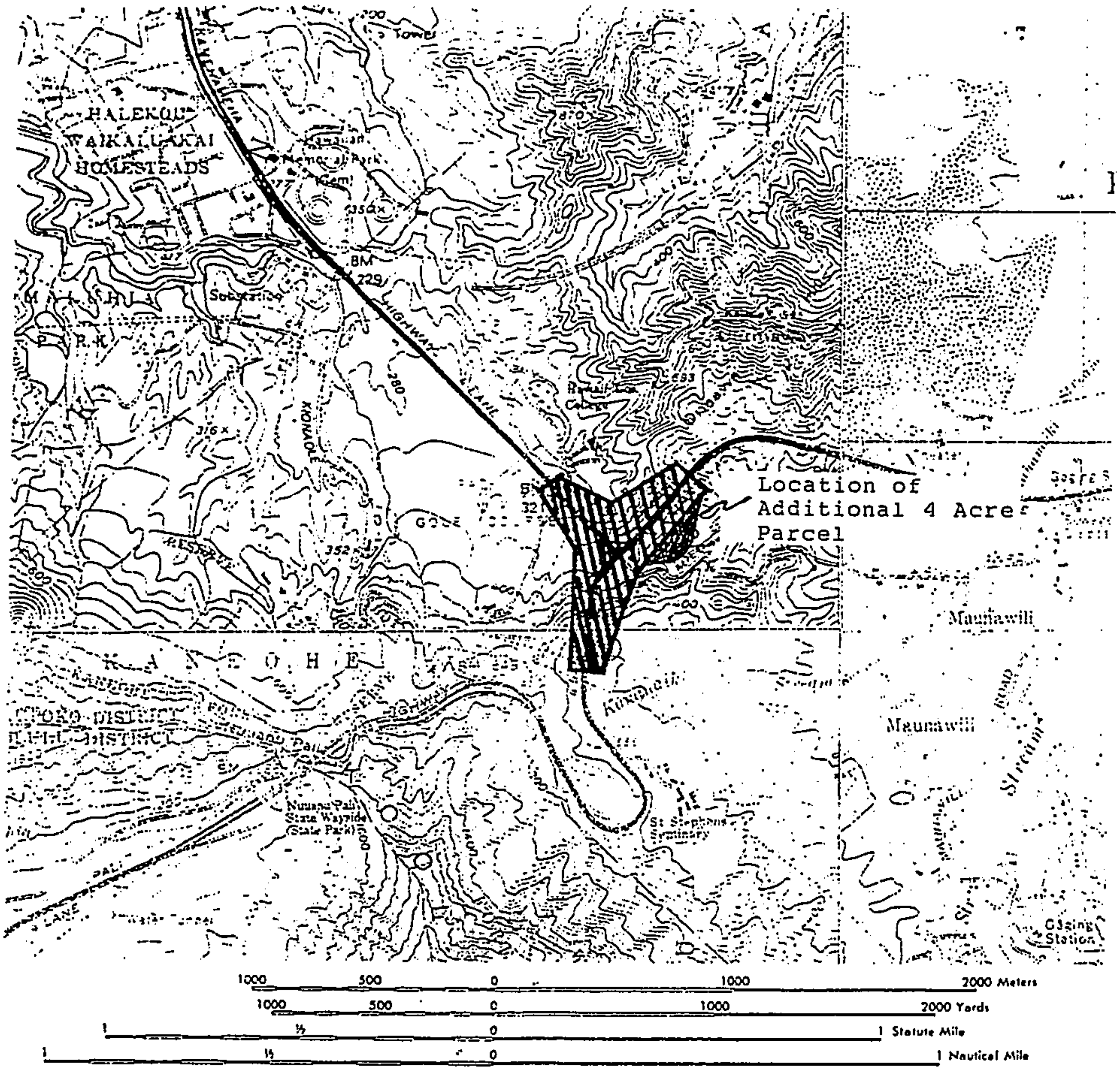

Figure 19 USGS Portions of Quad Maps Kane'ohe, Makapu'u, Kokohead, and Honolulu Showing Project Area

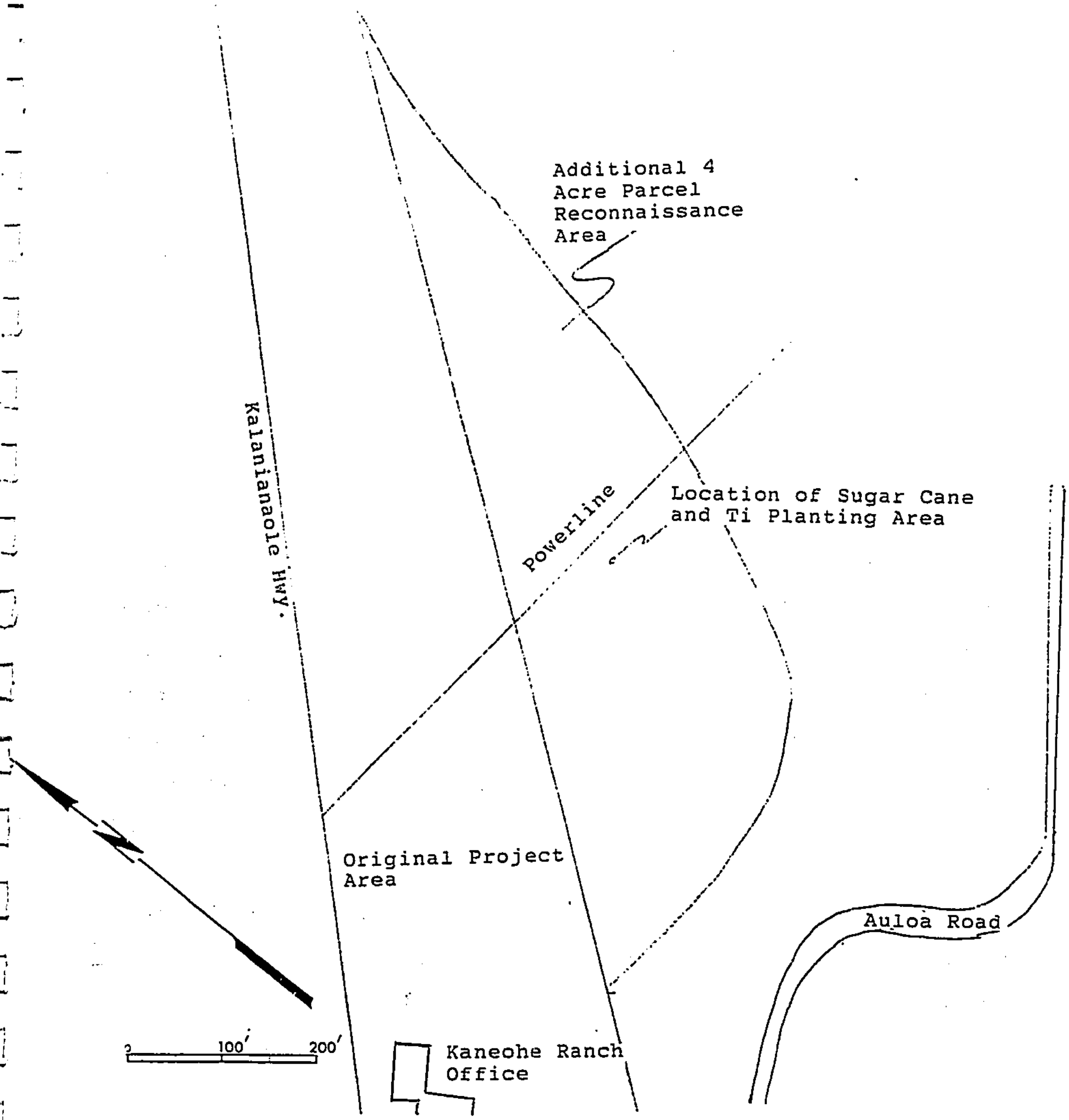

Figure 20 Sketch of Additional Four-Acre Parcel; Area Showing Location of Sugar Cane and Ti Planting Area

vines throughout. On the disturbed slopes nearest to Kalanianaole Highway ferns and vines form the dominant ground cover.

Reconnaissance was by repeated pedestrian sweeps with access from Auloa Road. Particular attention was given to gentler slopes near the base of the gullies and to areas in which cultigens (mango, ti, sugar cane) were observed. No prehistoric archaeological sites or cultural layers were encountered. Just southwest of the powerline road (Fig. 20) a stand of native sugar cane and ti was noted. This area was closely examined but there was no sign of any archaeological feature. It was concluded that these are remnants of traditional cultivation but that there is no archaeological component at this agricultural site. No other trace of traditional Polynesian activity or early historic activity was noted. The portions of the project area near the gully bottoms were probably not chosen for agriculture because 1) there was probably never very much water in these gullies for irrigation 2) the gullies were narrow and heavily vegetated and 3) far better areas for agriculture were available closer to centers of population to the north and east.

The project area lies within the traditional land divisions of Palalupe and Kahoa. Our study of traditional land use and previous archaeology in the vicinity suggested that there was little utilization of this area in prehistoric and early historic times. No sites have been documented in the immediate vicinity. No sites were recorded in our reconnaissance. The only land modification observed is bulldozing associated with the establishment of a powerline. No further archaeological work is recommended. In the highly unlikely event that cultural remains of any kind, especially human burials are encountered during construction an archaeological and the State Historic Preservation Office should be contacted immediately.

Appendix H

EROSION ANALYSIS

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RJP

February 16, 1990

MEMORANDUM

TO: GEORGE KRASNICK
PROJECT MANAGER

FROM: RORY FRAMPTON
ENVIRONMENTAL PLANNER

RE: CASTLE JUNCTION INTERCHANGE
SOIL EROSION ANALYSIS

Attached is the completed Soil Erosion Analysis for the proposed Castle Junction Interchange Project. The findings are summarized as follows.

None of the interchange alternatives would directly affect any streams, wetlands or water resources in the area. The potential for indirect impacts, by way of increased sedimentation due to erosion, to nearby properties and critical areas such as Kawainui Marsh and Kamooalii Stream is considered low. Potential erosion problems due to soils exposed during construction would be reduced by adherence to City and County grading ordinances which require approval by the Department of Public Works of plans and procedures for soil erosion controls. Adequate controls should be incorporated on-site, at the potential source of any problems associated with construction. Prompt revegetation and landscaping of the site would provide short-term and long-term protection.

Construction would involve grading the exposed bluff, terracing and landscaping. Reduced slopes, terraced runoff control ditches and increased vegetative cover would reduce existing erosion problems and traffic hazards and would be a long-term beneficial impact.

PROPOSED CASTLE JUNCTION INTERCHANGE
SOIL EROSION ANALYSIS

INTRODUCTION

The purpose of this analysis is to evaluate the potential for erosion and sedimentation impacts during construction and after completion of the Castle Junction Interchange as proposed by the State of Hawaii Department of Transportation. Of primary concern is the potential impact of increased sedimentation to nearby properties and critical areas such as Kawainui Marsh and Kamooalii Stream. Although marshes and other ecosystems such as wetlands and estuaries are generally well adapted to high inputs of sediment, substantial increases in sediment load due to upstream disturbances may upset existing balances (Fukunaga and Associates, 1980). Besides harming the environment, soil erosion during construction may increase costs and cause delays.

The proposed project involves the construction of a highway interchange to replace the existing at-grade intersection at the junction of Pali Highway, Kalanianaole Highway (FAP Route 61) and Kamehameha Highway (FAP Route 83), also known as Castle Junction (Figure 1). All of the proposed interchange alternatives would provide a grade-separated structure for the Pali highway lanes, thereby eliminating the conflict between the Pali Highway through traffic and the Kamehameha Highway-Auloa Road traffic. Although the environmental assessment considers a non-structural alternative (TSM), this analysis considers the three alternatives involving actual construction, A, B and C, and the no-build alternative. The existing configuration is shown in Figure 2 and the interchange alternatives are shown in Figures 3, 4 and 5.

All grading and clearing would need to conform to Chapter 23, "Grading, Soil Erosion, and Sediment Control," Revised Ordinances of Honolulu 1978, as amended. This requires the submittal of a complete erosion control plan prior to project approval. At the time of this study, only preliminary design requirements have been developed and thus full identification of control measures, including construction scheduling, is not practicable. Therefore, this analysis is not intended to be a substitute for an erosion control plan, but rather, it is meant to identify important environmental concerns at an early stage in project development.

This analysis looks at three areas within the proposed project site and estimates erosion potential through use of the Universal Soil Loss Equation (USLE). These area are considered to be representative of critical or worst case areas. It is not the intent of this analysis to estimate total erosion from all areas of the project site but rather to evaluate potential impacts at critical areas of concern. General recommendations

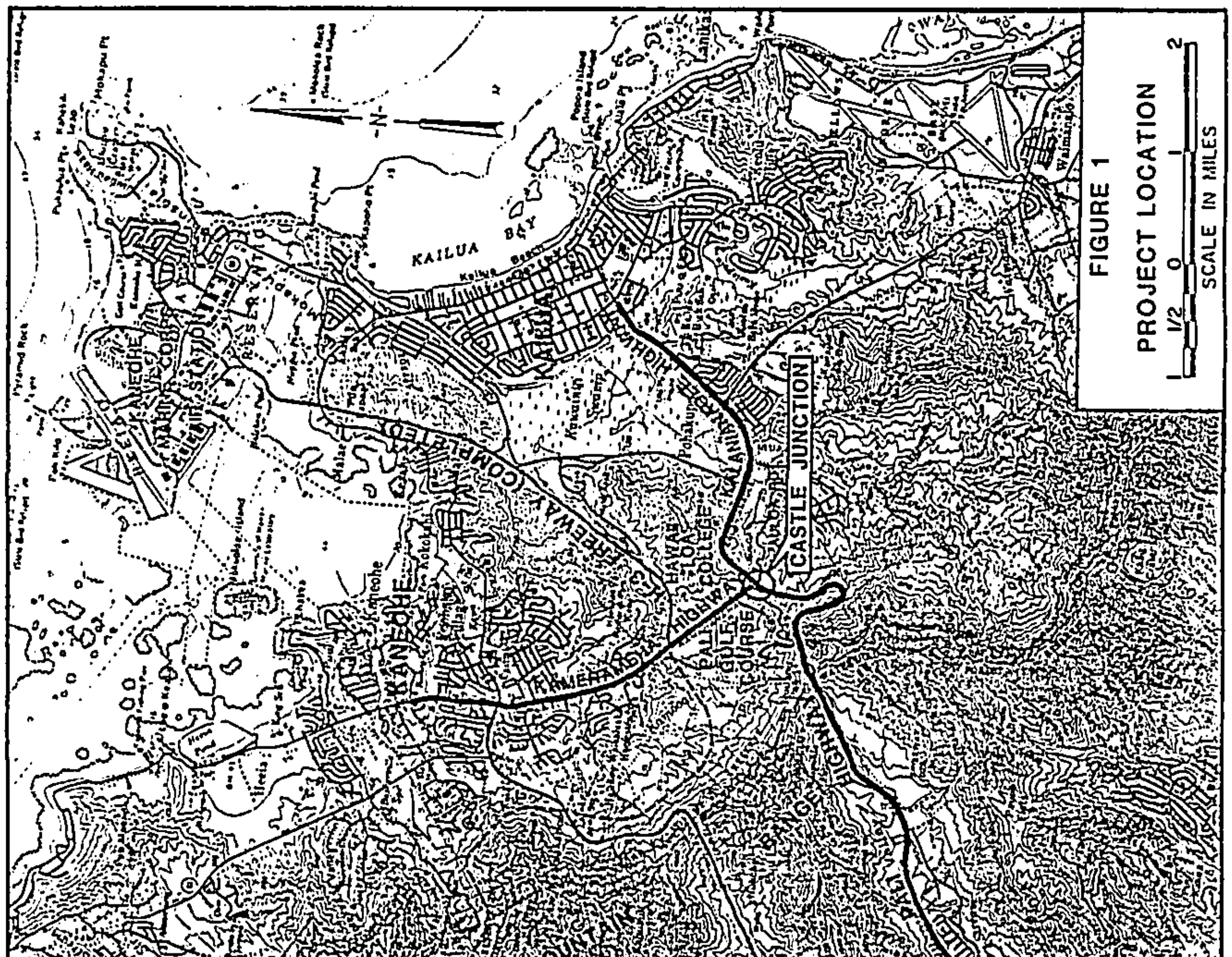

FIGURE 1
PROJECT LOCATION

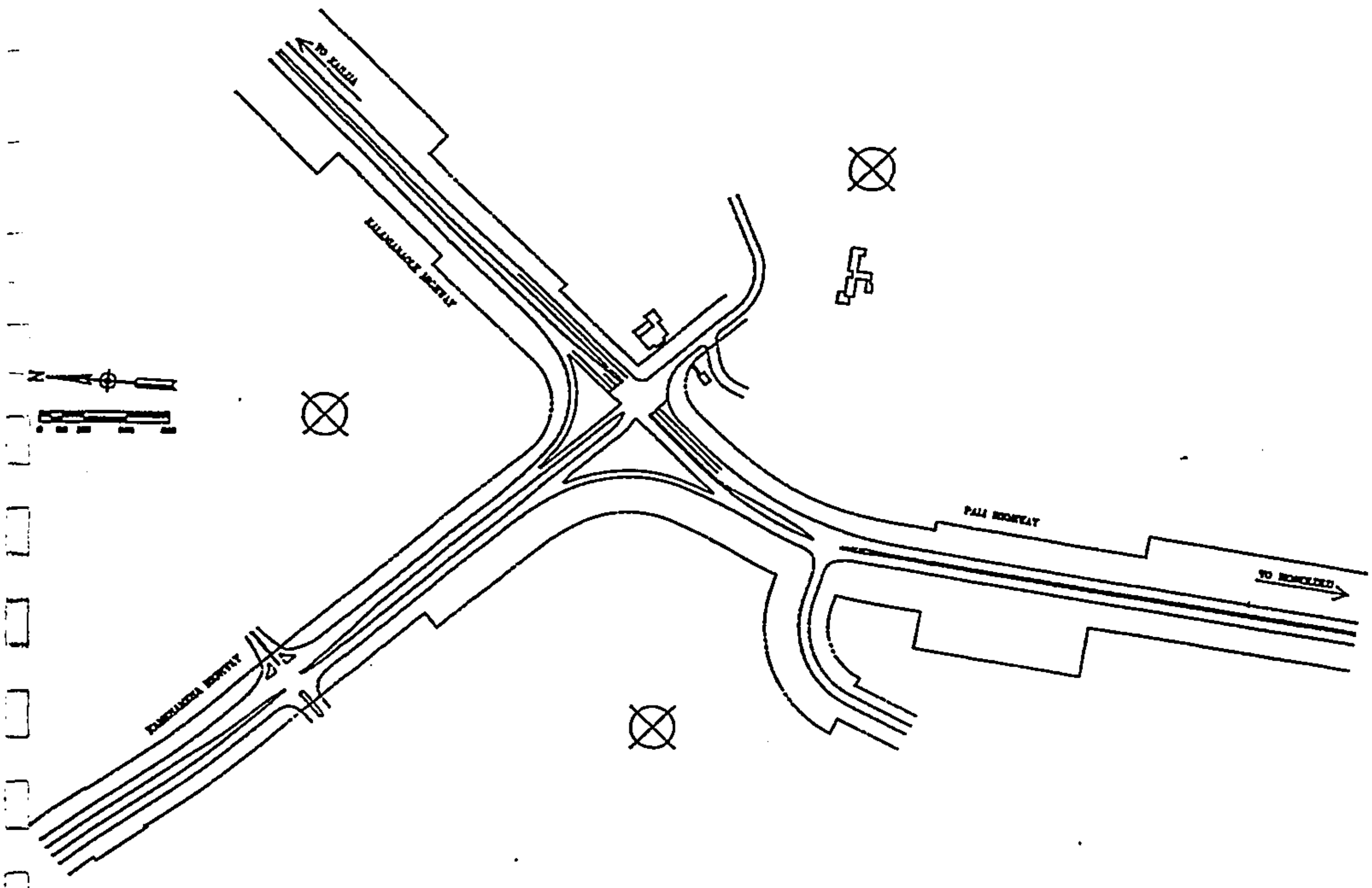

FIGURE 2
EXISTING INTERSECTION CONFIGURATION

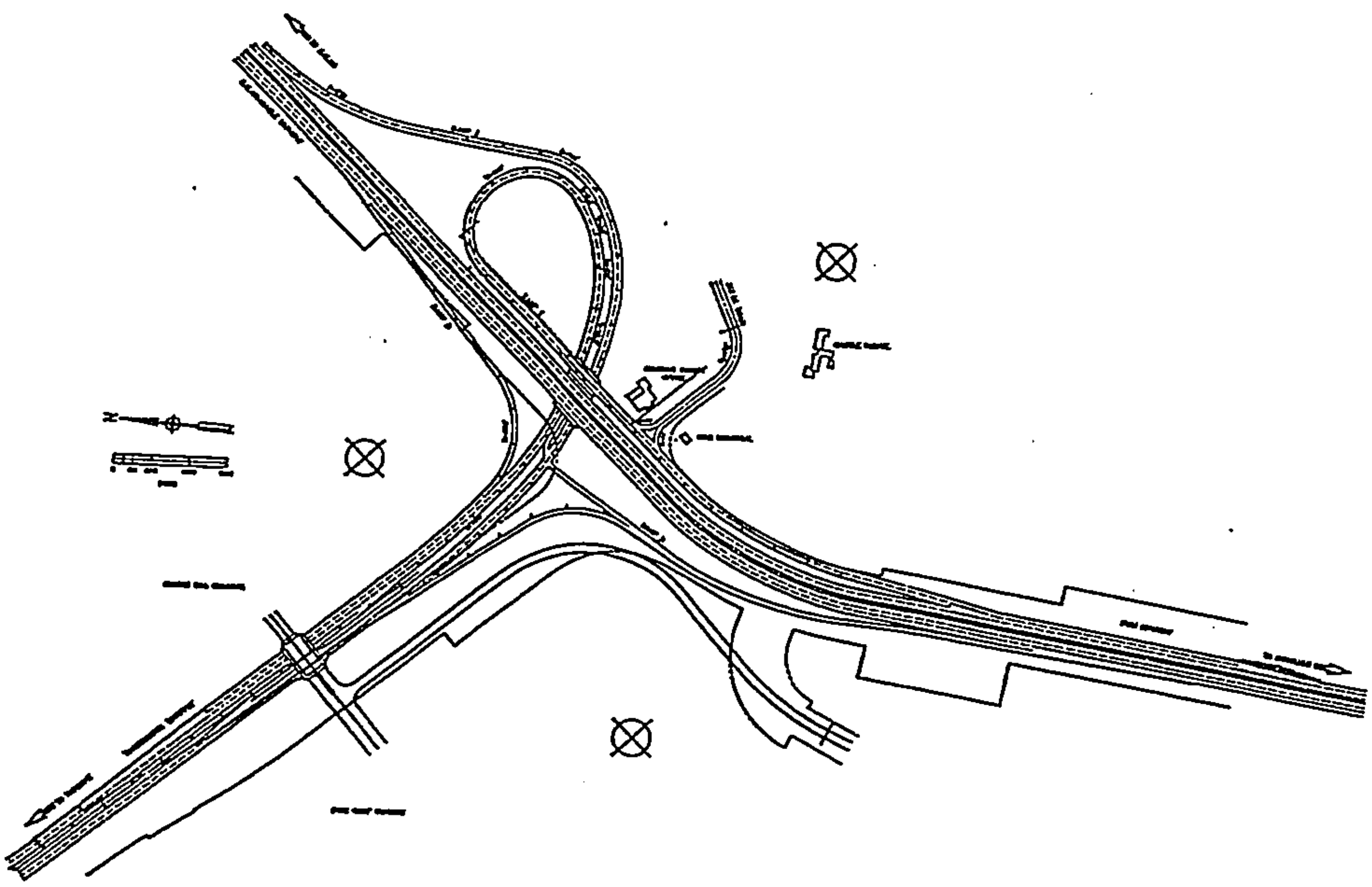

FIGURE 3
ALTERNATIVE A

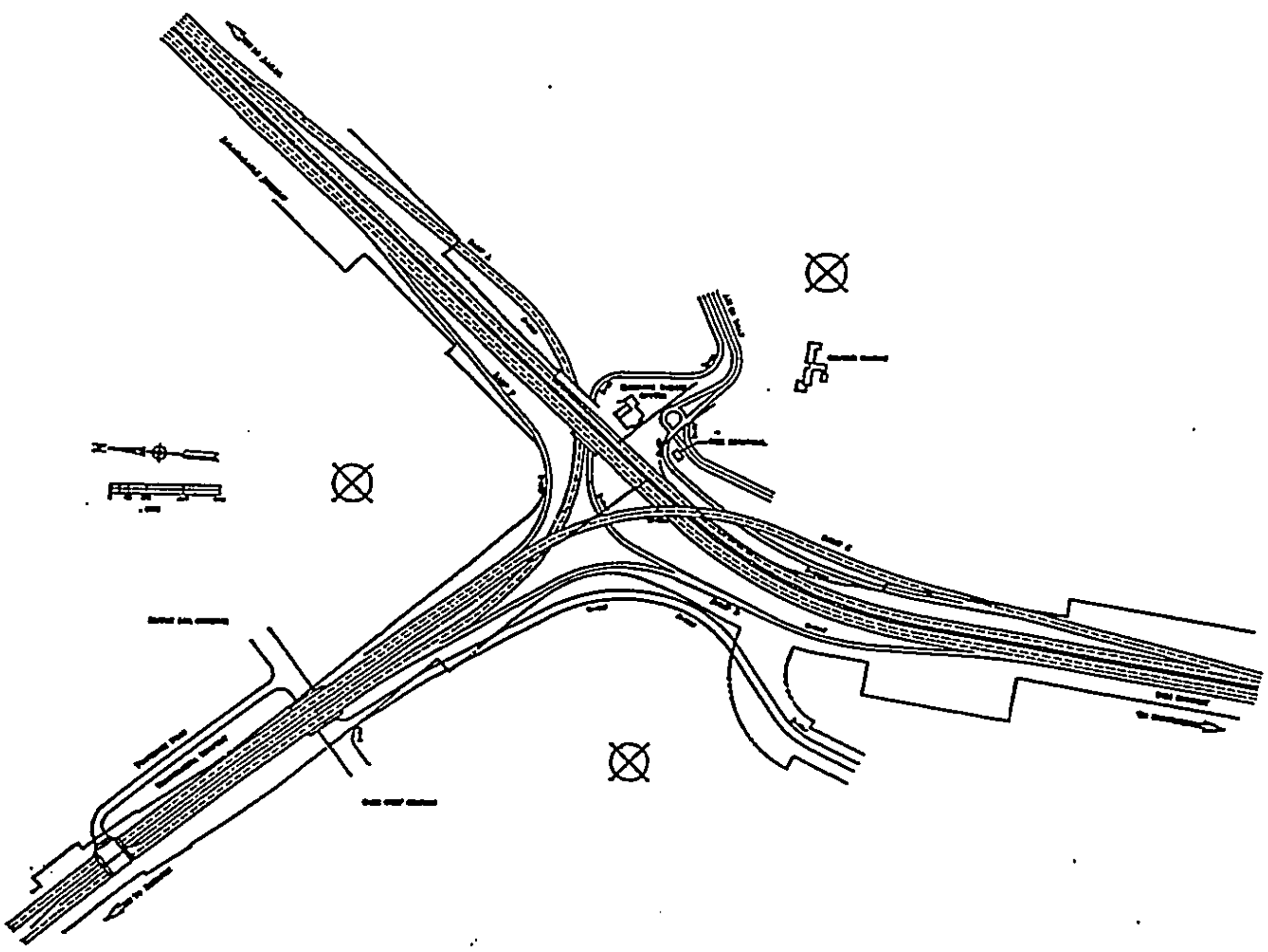

FIGURE 4
ALTERNATIVE B

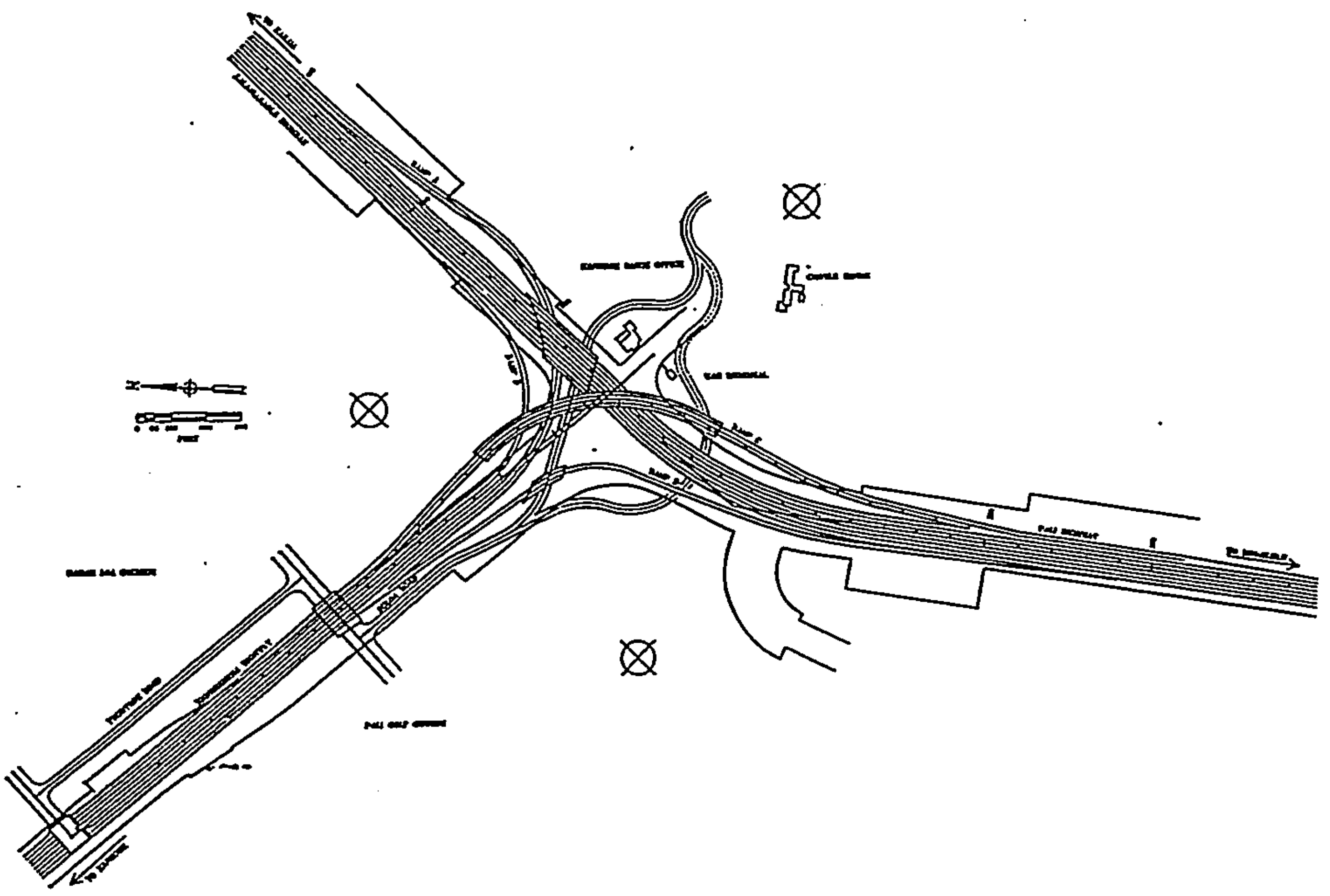

FIGURE 5
ALTERNATIVE C

and conclusions are made based on the results of the equation and other accepted principles regarding erosion control.

GENERAL SITE DESCRIPTION

The intersection occupies a low spot or saddle in the Oneawa Ridge which runs southwest from Ulumawao Peak towards the central core of the Koolau Mountains (Figure 6). As such the project site straddles the boundaries of two drainage basins. The intersection sits at the head of a deep valley to the east-northeast that drains a portion of the project area into Kahanaiki Stream. This stream is approximately 3/4 mile down-slope and eventually feeds into Kawainui Marsh. A lower ridge runs eastward from the intersection along the south side of Auloa Road.

To the west of the intersection is a gently sloped area (covered mostly by golf course) terminating at Hawaii Loa College against the mass of Ulumawao Peak. Surface drainage from this portion of the site flows into a basin on the Hawaii Loa College campus running northwest, roughly parallel and near to Kamehameha Highway, as part of the Kamooalii Stream Watershed.

Construction of the existing highways resulted in high cut and fill slopes. Dramatic cuts more than 50 feet high exist along the northwest side of Kalanianaole Highway, and lower cuts occur on both sides of the Pali Highway, near the southern end of the project area. Most of the slopes were cut steeper than 1:1.

Fill slopes more than 50 feet high exist along the southeastern side of Kalanianaole Highway, and lower fill slopes exist along both sides of Kamehameha Highway, including the southbound feeder lane onto the Pali Highway. Most of the fill slopes were constructed at slopes of about 1.5:1 (horizontal:vertical).

UNIVERSAL SOIL LOSS EQUATION

The U.S. Soil Conservation Service (SCS) Universal Soil Loss Equation (USLE) has been used in this analysis. It is important to recognize that numerical figures resulting from the use of the USLE are estimated and cannot be accepted as absolute. The equation was developed for agricultural lands and is to be used primarily as a planning tool (Yamamoto, pers. comm.). However, as part of the National Cooperative Highway Research Program, an experimental program was conducted to verify the applicability of the equation to highway construction sites (Israelsen, et. al. 1980a; 1980b). The program found that the USLE is probably the best tool available for predicting soil loss caused by rill and sheet erosion during highway construction and for estimating the

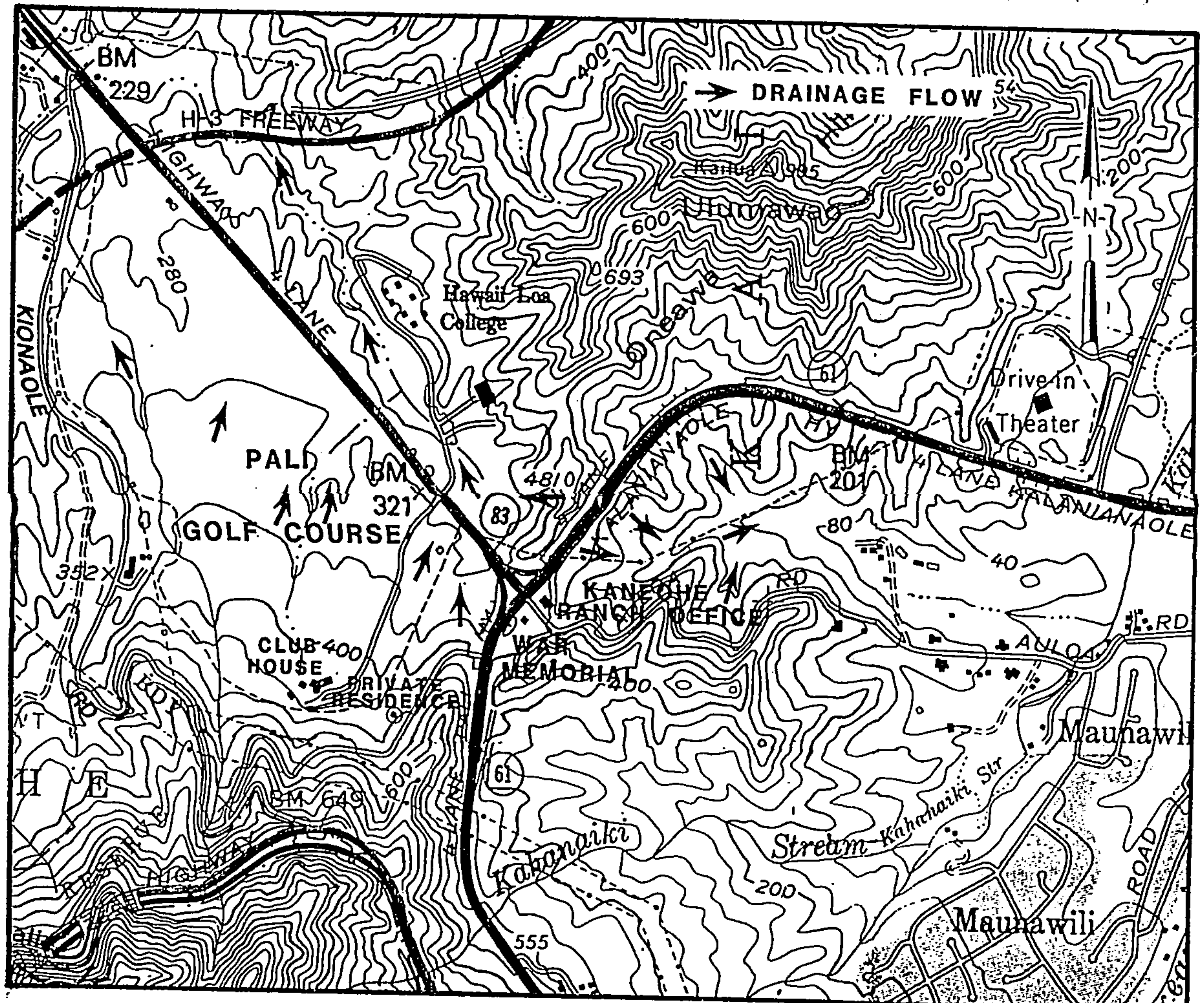

FIGURE 6 – GENERAL TOPOGRAPHY

relative effectiveness of various control measures. Accordingly, values obtained in this analysis have been used as relative measures of the potential for soil loss and to highlight critical control parameters.

The USLE computes gross sheet and rill erosion but does not directly predict downstream sediment yield. Materials derived from sheet and rill erosion often move only short distances and may lodge in areas remote from the stream system. Also, it does not account for gully and stream bank erosion which can be major components of the total volume of stream sediment (Nelson, 1983). Sediment delivery ratios often have been used to determine what portion of gross erosion from a drainage area is delivered at a location in the stream system (State of Hawaii Dept. of Health, 1978).

A study by Engineering Science, et al., 1972, indicated that storm runoff seemed to be the critical factor for Oahu watersheds. The results of the study showed the dependence of sediment loads on average storm runoff regardless of apparent differences in land use and other factors bearing upon sediment yield. In addition, the final report of the 208 Technical Committee on Nonpoint Source Pollution Control states that "...the state of the art in sediment delivery calculations is still too primitive to positively link a particular land activity with a specific amount of sediment deposition. Currently, we can only attempt to limit erosion through the implementation of BMP's [Best Management Practices] and assume that it will, in turn, reduce sedimentation" (1978, pg. 46). Thus, rather than attempt to predict sediment transport and potential changes to sediment loads in nearby streams, the focus here has been limited to on-site erosion processes and the potential to mitigate construction related impacts.

The USLE estimates the amount of soil loss expected in the average or normal year (tons/acre/year) under a specified set of conditions. The equation and its four major factors can be described briefly as follows:

A = RK(LS)(CP), where,

A = predicted soil loss (tons/acre/year)

R = total erosive effect of an average year's rainfall

K = soil erodability factor corresponding to the soil series at the site

LS= combination of slope length and steepness

CP= combined factor for the protective effect of ground cover and mechanical or engineering erosion control measures. [1]

LS and CP are the variable factors when estimating effectiveness of control measures. Essentially, LS, a topographical feature, can be reduced by berms, ditches or benches which reduce slope length and in turn the LS factor. CP values have been estimated for a variety of control measures which may be implemented, including vegetation, mechanical manipulation of the soil surface, chemical treatments, etc. (Israelsen, 1980b).

R is the number of erosion index units in a normal year's rain. When the period of disturbance or stages of conditions to be estimated exist for less than a full year it is necessary to use the proper fraction of the R value. This can be determined by use of curves for the expected monthly distribution of rainfall for given locations. Thus, while the yearly R value for a site is not controllable, monthly distribution curves may be used to predict the effects of starting construction at various times throughout the year, when the probability of erosive rainfall is relatively high or low. It should be stressed that these are statistically derived values and do not preclude the possibility of extreme events occurring during periods of predicted low erosive rainfall.

METHODOLOGY

Three areas within the project site were chosen to run the equation (Figure 7). Alternatives A, B, and C were examined at each area except for Alternative A at Area 1, due to the absence of preliminary design specifications. The areas were chosen based on extensive cut and fill activities which would be necessary to construct ramps for the alternatives. The resultant steep slopes would thus represent critical areas of concern. They also coincide with existing areas that have dramatic topographical features, namely steep, and in the case of Areas 2 and 3, sparsely vegetated slopes, associated with valley walls or prior cut and fill activities.

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[1] In the USLE, as utilized by the Department of Agriculture for agricultural crops, C and P are separate factors; C is the cover and management factor and P is the erosion control practice factor having to do with contour and type of strip cropping. On non-agricultural land, P has a value of one and is not considered. The combination of C and P into one factor here is based on the City and County of Honolulu's <u>Soil Erosion Standards & Guidelines</u> (1975) and <u>Erosion Control During Highway Construction</u> (Israelsen, et. al. 1980b).

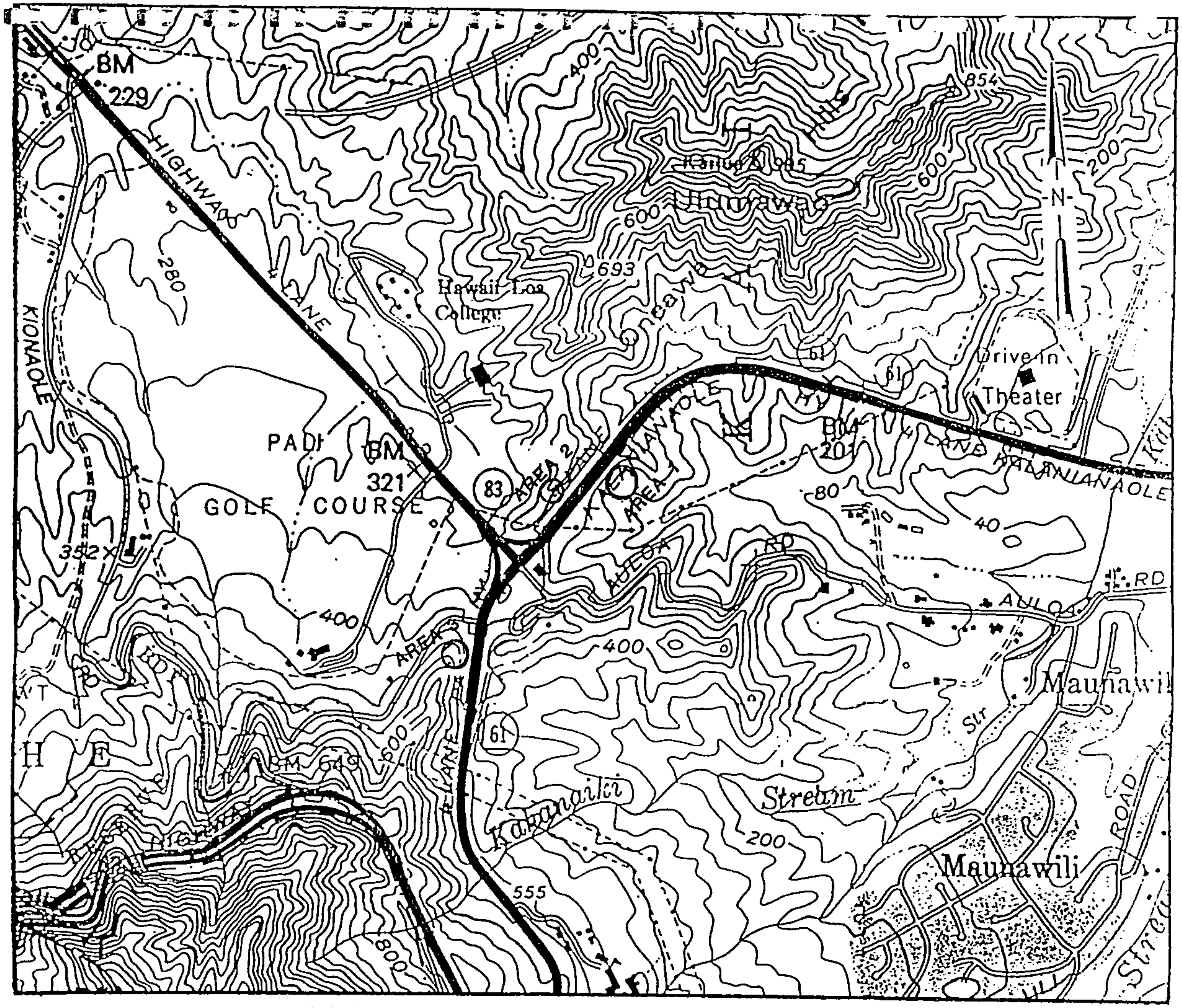

FIGURE 7 - MEASUREMENT AREAS

Area 1 is on the southeast side of Kalanianaole Highway approximately 500 feet from the current intersection and is associated with Ramp A in the alternatives. This area consists of moderate to heavy vegetation along a steep continuous slope to the valley floor. Area 2 is northwest of Kalanianaole Highway approximately 350 feet from the center of the current intersection and is associated with Ramp B in the alternatives. It is a steep sparsely vegetated area shaped partially by cuts from construction of the existing Kalanianaole Highway. Area 3 is on the west side of the Pali Highway approximately 500 feet from the current intersection and is associated with Ramp D in the alternatives. Like Area 2 it is a steep sparsely vegetated slope shaped by cuts for construction of the Pali highway.

Slope length and gradients were obtained from profile maps used for preliminary determination of cut and fill requirements for the three interchange alternatives.

The equation was run under six conditions at each area for each alternative: "existing", "no mitigation", three sets of mitigation measures implemented during a hypothetical construction year, designated "Miti-1", "Miti-2", and "Miti-3", and, "post construction".

Values under existing conditions represent those expected from the no-build alternative. The equation was run for each alternative at an area due to slight differences in actual locations of alternatives at each area.

All three combinations of mitigation measures use a CP value associated with bare ground conditions for two months of construction and values for conditions associated with permanent seedings planted immediately after construction for the next ten months (Table 2-2, Transportation Research Board, 1980b). "Miti-1" involves dividing the slope length in half, representing construction of one diversion ditch or berm. "Miti-2" involves reducing the slope length to 50 feet. (If dividing the slope length in half in "Miti-1" results in a slope less than 50 feet "Miti-2" is not run.) "Miti-1" and "Miti-2" were run assuming that construction is started at the beginning of the dry season. "Miti-3" involves the same set of parameters as "Miti-2" except that construction is assumed to start at the beginning of the wet season.

The combinations of controls are representative of absolute minimum measures which could be implemented and do not include alternatives not applicable to the USLE such as settling basins.

For the "post construction" conditions it is assumed that vegetative landscape has taken firm hold with slope lengths the same as those in "Miti-2".

Soil series were obtained from the report Soil Survey of the Islands of Kauai, Oahu, Maui, Molokai and Lanai, State of Hawaii, U.S. Dept. of Agriculture, Soil Conservation Service. K values have been established for these soil series and their sub-soils (City and County of Honolulu, 1975). For purposes of this analysis it has been assumed that soil series at the areas will remain the same after cut and fill activities. Although this is unlikely given the amount of filling which will take place in some areas, it is impracticable to establish the qualities of any imported fill soils when it is uncertain if, and to what degree, this will occur.

RESULTS

Tables 1, 2 and 3 show the results of the equation run at the three areas for each alternative under the six different conditions.

For Areas 2 and 3 conditions under "no mitigation" results in values averaging approximately ten times those under "existing" conditions. Area 1 has values approximately twenty five times those of "existing" conditions.

In Areas 2 and 3, when construction is initiated during dry months ("Miti-1" and "Miti-2"), values are lower than the "existing" conditions. For all alternatives run with "Miti-3", when construction is initiated during the beginning of the wet season, values are roughly double those found under "Miti-1" and "Miti-2" and well above those under "existing" conditions.

None of the mitigation measures applied during the hypothetical construction year in Area 1 result in values below "existing" conditions.

"Post-construction" values for all areas are well below values under "existing" conditions.

TABLE 1
ESTIMATED SOIL LOSS
(TONS/ACRE/YEAR)
AREA 1

ALTERNATIVE	EXISTING	NO MITIGATION	MITI-1	MITI-2	MITI-3	POST CONST.
A	n/a	n/a	n/a	n/a	n/a	n/a
B	181	2577	349	247	668	14
C	172	2500	302	246	668	14

TABLE 2
ESTIMATED SOIL LOSS
(TONS/ACRE/YEAR)
AREA 2

ALTERNATIVE	EXISTING	NO MITIGATION	MITI-1	MITI-2	MITI-3	POST CONST.
A	313	2760	334	247	668	14
B	387	1798	211	211	571	12
C	337	1533	192	192	519	11

TABLE 3
ESTIMATED SOIL LOSS
(TONS/ACRE/YEAR)
AREA 3

ALTERNATIVE	EXISTING	NO MITIGATION	MITI-1	MITI-2	MITI-3	POST CONST.
A	223	1629	195	145	393	8
B	236	1935	233	145	393	8
C	299	1621	187	132	358	8

DISCUSSION

What is immediately apparent are the high levels of erosion predicted under the "existing" conditions. This is in part explained by existing steep slopes (54% for Area 1 and approaching 100% for Areas 2 and 3) and a high rainfall factor for the entire site (450). This is compounded at Areas 2 and 3 by sparse vegetation and at times barren conditions which translate to high CP values. Therefore, comparisons with "existing" conditions should be made with care as these levels represent severe conditions. For comparison purposes, it was estimated that areas in the Kaneohe region in general have erosion in the 2-20 tons/acre/year range (Bartram, 1976).

As shown in the tables, the "no mitigation" conditions result in extreme increases over "existing" conditions. These values are largely due to the assumption that bare soil conditions would exist for an entire year. In reality, these conditions would not occur as controls would be required by the City and County's erosion control ordinance.

In all cases the "post construction" year values are well below "existing" levels and coincide with the range of estimated values for the Kaneohe region. The major factors contributing to the lower values are the establishment of permanent vegetative ground cover which results in CP values lower than "existing" conditions and reduced slope lengths due to drainage ditches or berms.

The most critical period for the hypothetical year used in this analysis is the initial two months of construction under bare soil conditions. As shown in the tables in Appendix A, values during these 2 months account for 60-75 percent of yearly totals. The CP value used during this period assumed no controls would be in place. Additionally, other controls which could be applied to reduce sediment delivery, such as settling basins, were not considered as they are not applicable to the USLE. There exist substantial control measures which could and should be implemented during this stage.

The results also indicate how the distribution of rainfall can greatly influence high erosion levels. When construction is assumed to start at the beginning of the dry season, critical periods of high CP values - bare ground during construction for 2 months and while the seedlings are taking hold for the next 2 months - coincide with a period, May through August, where only 14% of the erosive rainfall is expected to occur (values derived from Expected Monthly Distribution of Erosive Rainfall for Windward Oahu figures in U.S. Dept. of Agriculture, 1981). However, when the same controls are used and construction is initiated in the beginning of the wet season, 54% of erosive rainfall is likely to occur during these first four critical months and erosion rates nearly triple. This highlights the importance that timing and sequencing can have. However, it is important to stress the fact that the distribution of erosive rainfall is statistically derived based on past records. Thus, the lower values are representative of lower probabilities and do not preclude the possibility of extreme events occurring during "dry" seasons.

While none of the combinations of controls applied at Area 1 reduce predicted erosion values below "existing" levels this does not imply that this will be the case during actual construction. As previously mentioned, the mitigation combinations represent minimum controls. What it does indicate is that this represents an area of critical concern due to the long steep fill slope that would be required to accommodate Ramp A in Alternatives B and C.

CONCLUSIONS AND RECOMMENDATIONS

The potential exists for significant increases in soil erosion during the construction phase if adequate controls are not designed and implemented. However, techniques do exist which, given proper timing and implementation, could reduce potential increases to acceptable levels (City and County of Honolulu, 1975; Israelsen et. al., 1980b). The proper combination of controls should be selected when the final alternative has been chosen and design specifications are more detailed. Of course, complete adherence to the City and County's soil erosion standards and guidelines should occur.

It is strongly recommended that major earthmoving and grading activities be coordinated and timed in order to minimize the probability of erosive rainfall. However, this should in no way reduce the care and attention given to the design and implementation of controls.

It should be stressed that besides minimizing the potential for environmental degradation and damages to adjacent properties, overall construction costs are likely to be lower if control measures are implemented than if they are omitted. This is especially critical in areas where earthmoving activities will be performed up-slope of highways and construction areas. Additionally, it should be pointed out that numerous small control measures implemented at the proper times and locations may be more effective than a few poorly timed ones.

In summary, while the project does present some cause for concern with regards to potential increases in erosion during construction activities, adherence to the Chapter 23, "Grading, Soil Erosion, and Sediment Control," Revised Ordinances of Honolulu 1978, as amended, and proper implementation of needed controls can be expected to adequately mitigate potential problems. In the long term it is expected that severe erosion problems associated with existing steep barren slopes will be improved primarily through landscaping and reduced slope steepness and lengths.

This analyses has looked at three specific areas which were deemed to be critical. This does not imply that these are the only critical areas, nor does it diminish the importance of designing and implementing control measures for all areas at the site.

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Appendix I

VIEWS

DMJM Hawaii

Daniel, Mann, Johnson, & Mendenhall
Central Pacific Plaza
Suite 1570, 220 South King Street
Honolulu, Hawaii 96813
Telephone: 808/538-6747

Planning
Architecture
Engineering
Program/Construction
Management

transmittal

To: Parsons Hawaii
567 South King Street, Suite 105
Honolulu, Hawaii 96831

Attention: George Krasnick

Date February 28, 1990
Project Castle Junction

Re: Visual Analysis

DMJM Job No.

Gentlemen:
We are forwarding:

- [XX] Enclosed
- [ ] By mail
- [ ] Separate cover
- [XX] By messenger via Quick Quorier
- [ ] By blueprint company
- [ ] Other

Attached herewith, please find one (1) copy of the following:

Impact on Views;

Sketches of views from the 3rd floor of the Hawaii Loa College Campus. Existing View, Alternative A, Alternative B, and Alternative C.

If there are any questions or comments, please contact our office.

Remarks

Daniel, Mann, Johnson, & Mendenhall

By
James E. Zemski,
Project Manager

JEZ/lkw

Impact on Views

Presently, Castle Junction and Pali Highway has little visual impact on Hawaii Loa College. Figure 1. This is mainly due to the hill, with its lush vegetation, that separates the school grounds and Pali Highway.

Kamehameha Highway is visible from the school. Trees and plants along part of the highway does enhance the view. Cars are, at times, backed up along the highway due to the present intersection design.

To alleviate the congested condition at Castle Junction, three alternate schemes have been developed. Their visual impact varies to some degree, but will in general not significantly change the view from the college.

Alternative A (Figure 2) will have the least impact, due to the fact that Kamehameha Highway will basically remain at its present elevation but moved slightly closer to Hawaii Loa College. An underpass will connect Pali Highway and Kamehameha Highway. This will not be visible from the college. In all the alternate schemes, the hill will be cut back somewhat to improve the highway design. This will only slightly impact the view from the college.

Alternative B & C (Figure 3, 4) will use overpasses to connect Pali Highway and Kamehameha Highway, and will therefore have a slightly higher visual impact from the third floor library at the college. These schemes also provide a change in elevation of Kamehameha Highway. The highway will be raised approximately 25' to provide for an underpass connecting the college and Pali Golf Course. This will provide for a smoother traffic flow, but the highway will be more visible from the college. The entrance to the school has been moved further away from the intersection and a frontage road has been added in both schemes.

Scheme B & C also call for a cut into the hill, scheme C more so than B. The visual impact from the college should be minimum as the cut will be on the Highway side. Large amounts of trees will still shield the view of the Pali.

The new design of the intersection will not impact the view from the college grounds. The Pali Highway will only be seen from the third floor of the library. Kamehameha Highway will be more visible, especially in scheme B & C, but their impact could easily be reduced by planting trees along the highway.

A well designed intersection scheme might improve the view from the school as the traffic will flow smoother in all directions, therefore preventing the unpleasant sight of traffic jams.

MC/lkw
02279004.

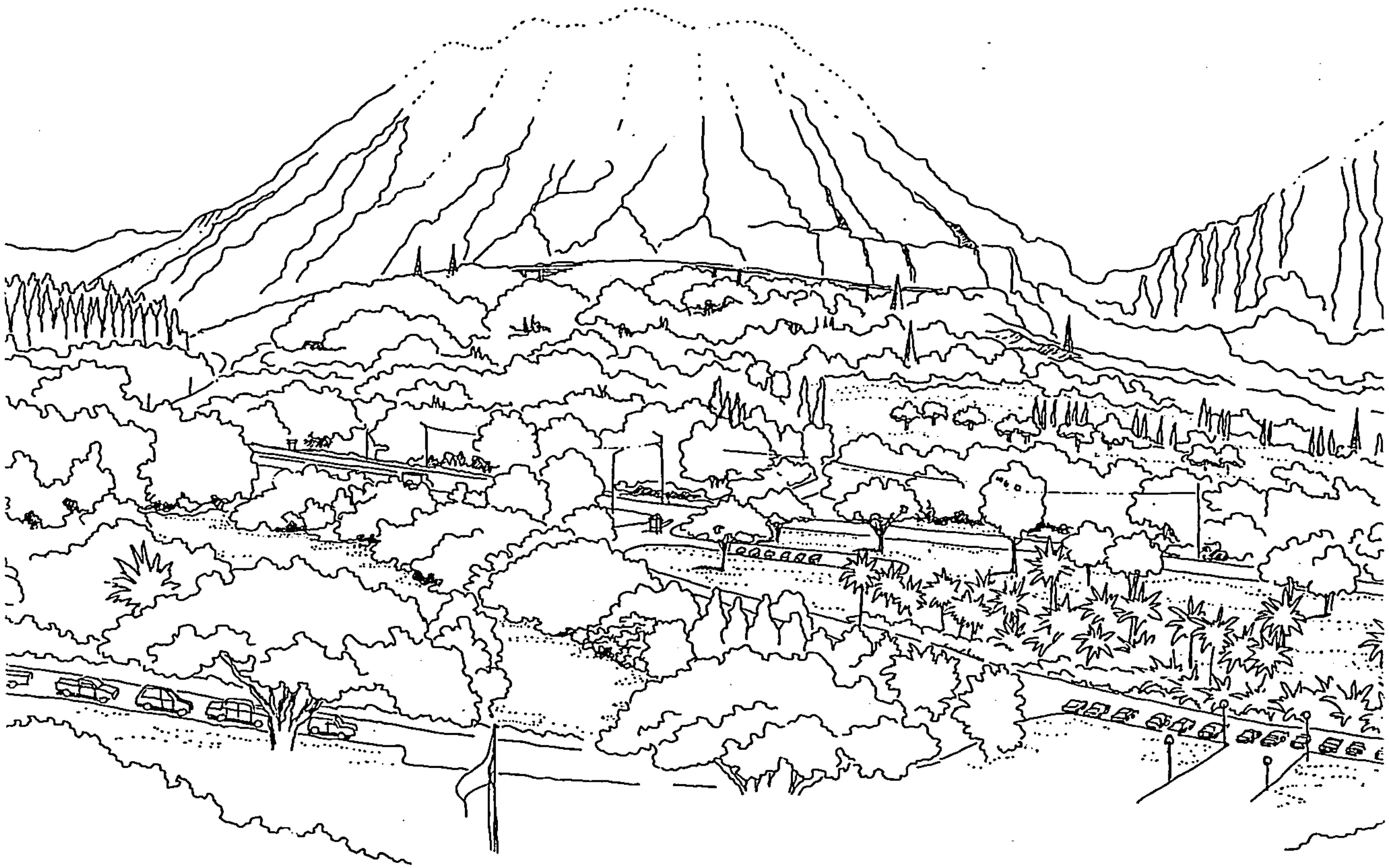


Figure 1 · Existing View

Figure 2 Alternative A

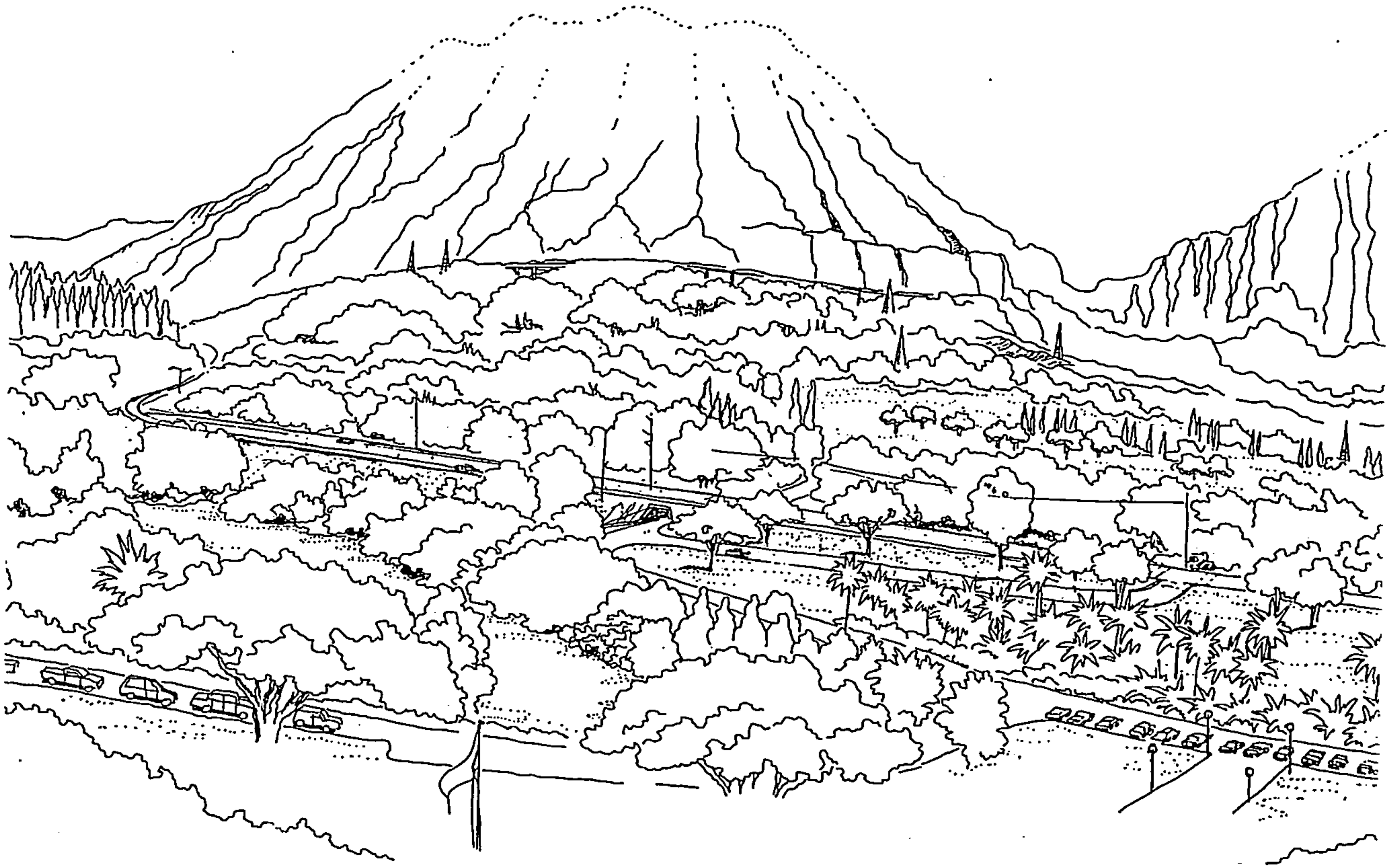


Figure 3 Alternative B

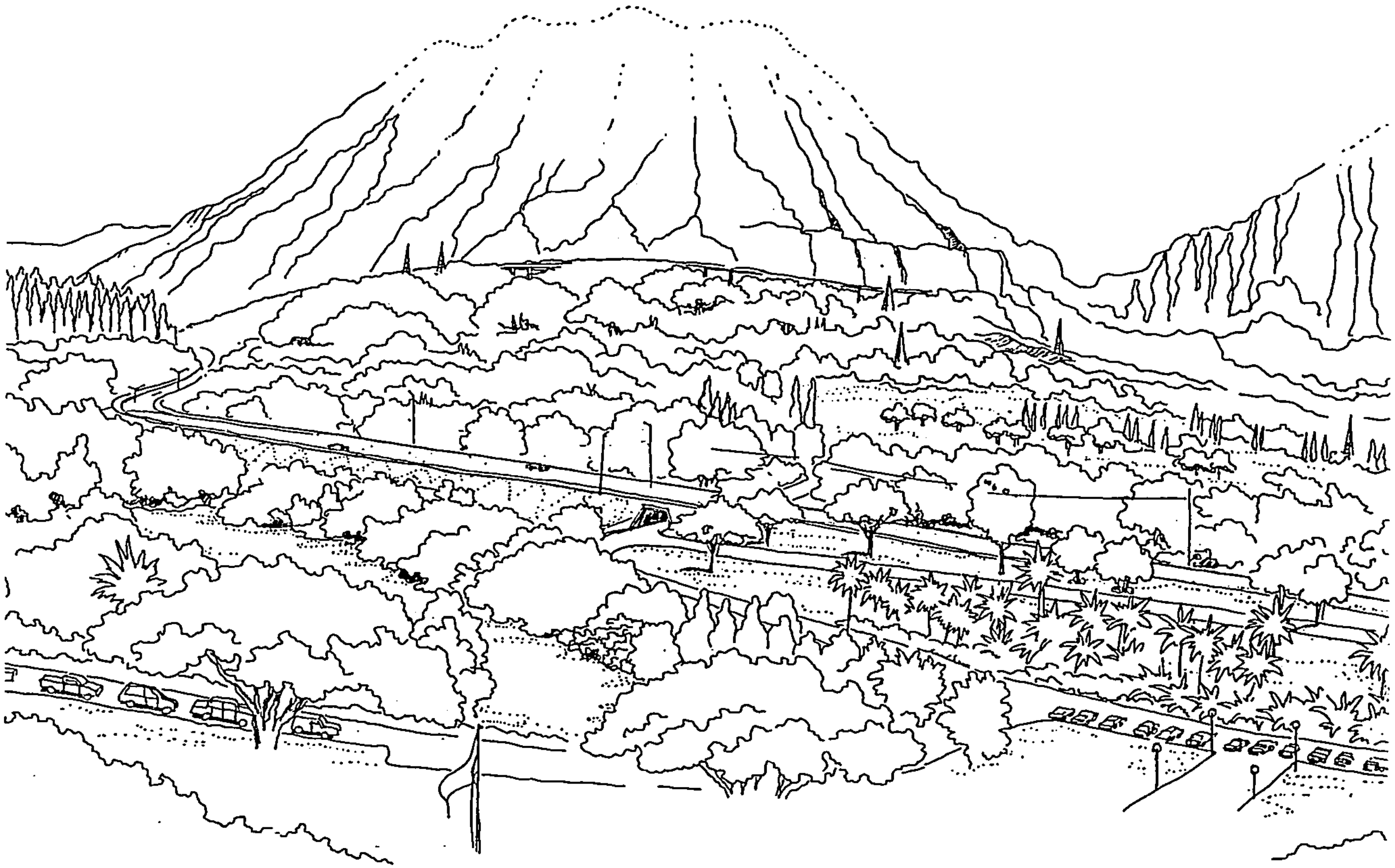


Figure 4 Alternative C

Appendix J

SUMMARIES OF PUBLIC INFORMATIONAL MEETINGS AND PUBLIC HEARING

PUBLIC INFORMATION MEETING

CASTLE JUNCTION INTERCHANGE

June 19, 1989

KANEOHE ELEMENTARY SCHOOL CAFETORIUM
45-495 Kamehameha Highway
Kaneohe, Oahu

MINUTES

1. Opening Statement - Mark Hastert, Commissioner on Transportation.

   a) Introduction of prominent guests: Representatives Ed Bybee and Marshall Ige

   b) Description of purpose of meeting:

      o Inform public of present status of DOT plans

      o Identify those with specific inputs and/or particular perspectives of value to the planning process

      o Receive input and recommendations for DOT evaluation in development of this project

   c) Statement of meeting procedures

   d) Preview of meeting agenda

2. Project Scope and Schedule - George Krasnick, Project Manager, Parsons Hawaii

   a. Background:

      o Major intersection modification first proposed in 1970

      o 1970 study recommended that intersection be designed with partial access control

      o Intersection at that time operated at Level-of-Service E, or worse (on a scale of A to F)

      o Recommended design was a grade - separated, trumpet-shape with ramps located in NE quadrant to minimize impacts on adjacent land uses. Direct ramps in NW and SW quadrants to remain as is.

b) Scope of Study:

- o Conceptual design of interchange alternatives. (Began with 10, including those from 1970 and have reduced to 6 for this meeting. None of these yet final.)

- o Preliminary planning and engineering. (Plans and profiles, drainage and utility considerations, etc., to be completed)

- o Environmental impact analysis. (Intention is to prepare a full Environmental Impact Statement. Alternatives will include the three final design alternatives, the "no-build," and "transportation system management" or TSM. The latter includes such things as increased ride-sharing, flex-time, etc.

  Field work for the EIS will include traffic counts, aerial photography, soils analysis, noise measurements, air quality measurements, and flora, fauna and archaeological surveys.)

c) Schedule:

- o Began in April, 1989, and environmental field work now underway

- o Public meeting #2 near end November, 1989

- o Draft EIS complete in March, 1990.

- o Public Hearing in April, 1990.

- o Final EIS complete in September, 1990.

3. Design Alternatives - Phillip Rowell, Traffic Engineer, Barton-Aschman Associates

   a) Slide presentation of existing conditions

   b) Slide presentation of constraining factors (including Pali tunnels, Pali bridges, Pali Golf Course, Hawaii Loa College, Kaneohe Ranch House, War Memorial Monument, stand of pine trees to NE, steep bluff to SW, valley to SE, Castle house, Wong house and access)

   c) Slide presentation of alternatives designs

4. Break/Examination of Exhibits

5. Comments, Questions and Answers

Q: Will pedestrian access to bus stops be studied?

A: Yes. This will be addressed in the EIS. Bus stops will have to be moved, hopefully to more convenient and safe locations.

C: I hope it won't be 5-7 years before the legislature is approached for money.

R: Overall timing depends on Federal funding, not just money from the legislature.

C: Just because H-3 will be built, it doesn't follow that Castle Junction traffic will decrease, and any scaling-down of plans is not justified.

Traffic counts should be done when school is in session. A population base of nearly 100,000 people use the interchange, and this project should be on the front burner.

R: When the entire H-3 is built, there will be an adjustment of living/working commute patterns, and DOT does feel traffic on the Pali will be lessened.

Q: What is the best realistic date when the interchange could be completed?

A: If funding is available in five years, it would take about 1-1/2 years to build.

C: Traffic coming down the Pali and turning Kaneohe Bound will encounter a new traffic signal at the golf course and two existing signals between there and H-3. The delays to Kaneohe-bound traffic will merely be shifted out of this intersection, while through traffic will be speeded.

R: The new signal at the golf course will operate at Level-of-Service C, as opposed to the present E or F. Long lines and waits will be avoided by shortening the signal cycle as much as possible.

C: Rerouting Auloa Road access through the golf course entrance is very circuitous.

R: Because of the long cycle time presently at Castle Junction, it can take 5 to as much as 10 minutes to get out of Auloa Road now. The new access road will be longer in distance, but significantly shorter in time.

Q: Is Kaneohe Ranch House immovable?

A: Yes, for all practical purposes. It is on the State and Federal Registers of Historic Structures.

Q: Are there interim plans for during construction or sooner?

A: Yes. DOT is presently constructing a second right turn lane from Kaneohe onto the Pali. For the longer term, one of the main criteria used in evaluating the design alternatives has been minimizing disruption to existing traffic during construction.

Q: Has traffic from the new golf courses in the area been factored into projections?

A: No, but typically golf courses are small traffic generators and most of the traffic is outside of peak hours.

Q: Have you considered double-decking the Pali?

A: No, because of several reasons. First, the highway is at near-maximum grade so it would be hard to ramp up to another level. Other factors include cost, disruption of traffic during the very long construction period, and the necessity to rebuild the Pali bridges to withstand the increased loads.

Q: Why don't you provide a direct off-ramp to Auloa Road?

A: It would involve either taking more of the stand of pines, Castle House or War Memorial, or, moving the entire highway towards the golf course.

C: Kailua people have struggled in this traffic for 20 years. We have problems even getting contraflow. We need immediate relief.

Q: Will cuts be mulched and planted?

A: Erosion is a concern. As a general policy, DOT does plant slopes.

C: It appears that the Auloa Road underpass may flood.

R: There is no dip there. Drainage will be into an existing culvert and then into the valley to the SE.

Q: Is there some way a second interchange can be built at Waimanalo Junction?

A: DOT has been looking at this, but for now it's a lower priority.

C: On behalf of the people of Kaneohe and Kailua, we wonder why the voices of the people in Kalihi and Nuuanu are heard so much more loudly than those on the windward side. We've had 20 years of misery and we think it could be shared a little for the next 5 years until H-3 is built.

R: Contraflow encountered organized opposition in Nuuanu and Kalihi. Unless we get some kind of consensus in the community about contraflow, we will have problems getting it implemented. We are going to need a lot of support from windward people.

Q: What level of federal participation can you get for this?

A: 75%

Q: What will the interchange cost?

A: It varies by design, but roughly $8-10 million.

Q: Will we get to see the EIS when it's done?

A: Yes. Copies of the draft will be available at OEQC and the public libraries.

Q: Can we get on a mailing list for copies?

A: Yes, especially if you represent a community association. Contact OEQC.

Q: Why can't we use some of the State surplus for this project?

A: The source of the surplus is the general fund. The highway program is user-oriented, has its own fund, and does not have access to the general fund. Highway improvements are funded from the gas tax, the vehicle weight tax, registration fees and the general excise tax on fuel.

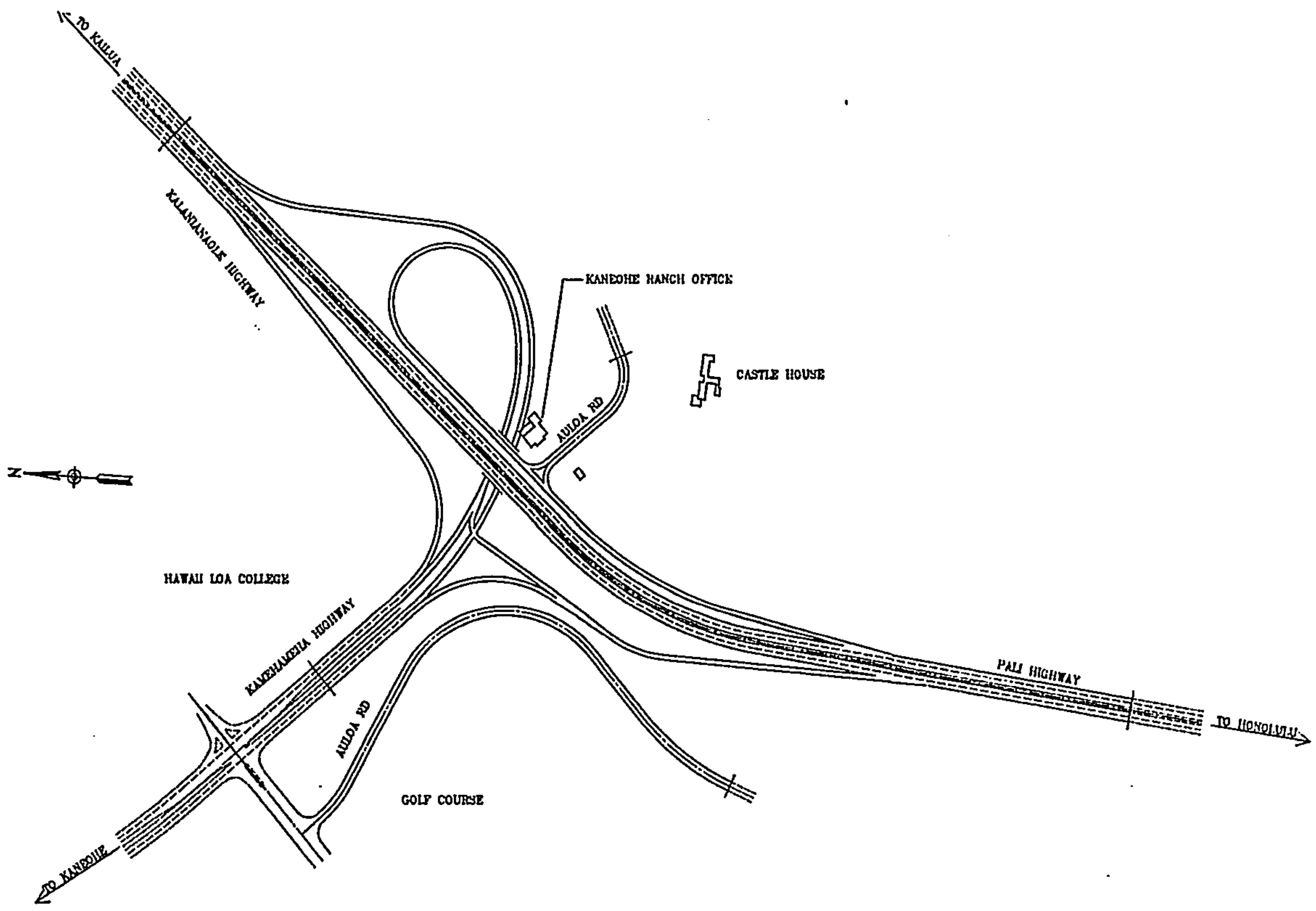
Q: Why not use a turnpike concept?

A: That's a good idea, but presently there is no legislation permitting it.

C: If you want more information, please contact Kenneth Au at 548-3258.

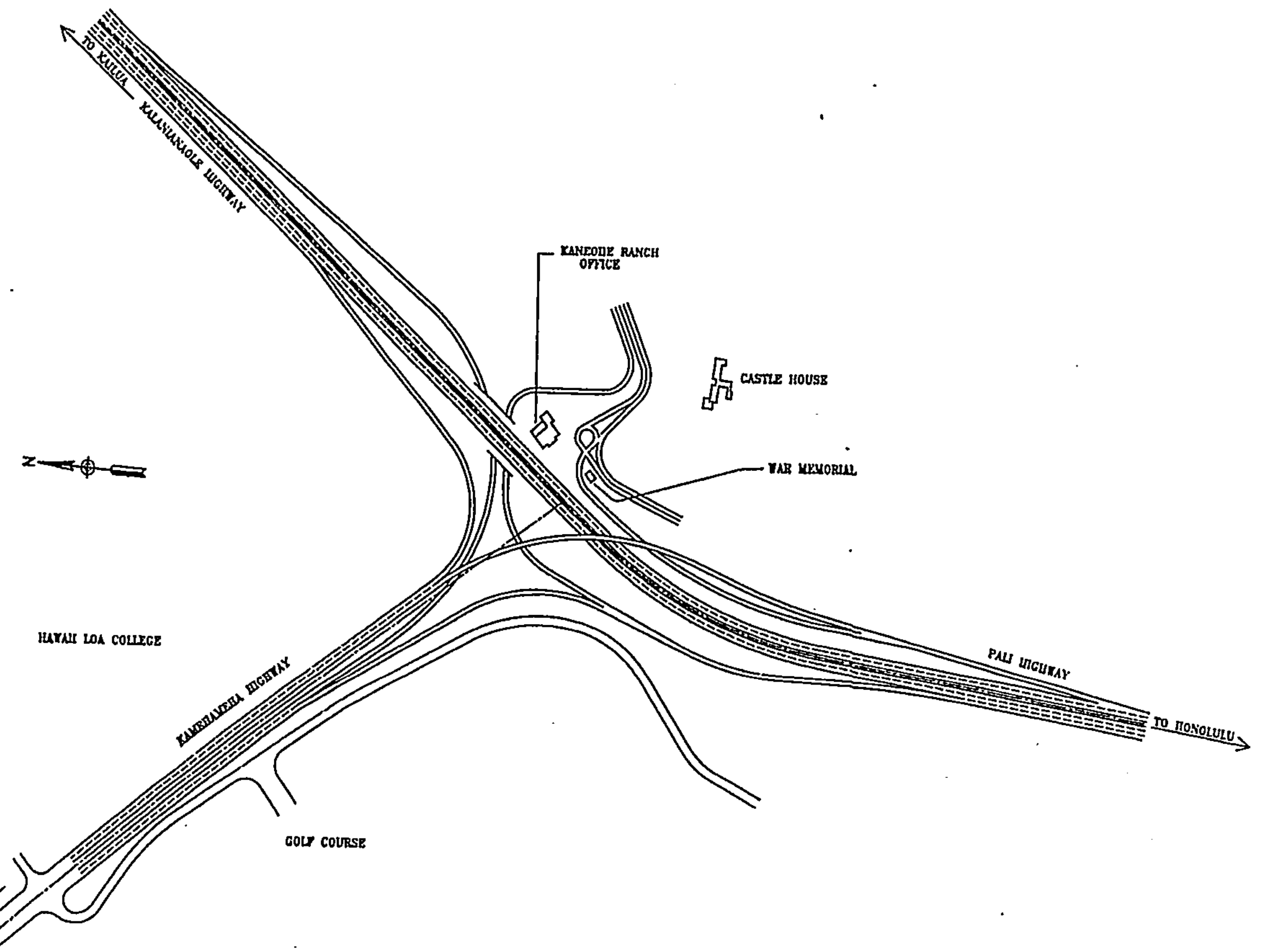
Q: Can we get copies of the drawings and the minutes?

A: Yes. They will be distributed to those who sign up on the sheets in back.



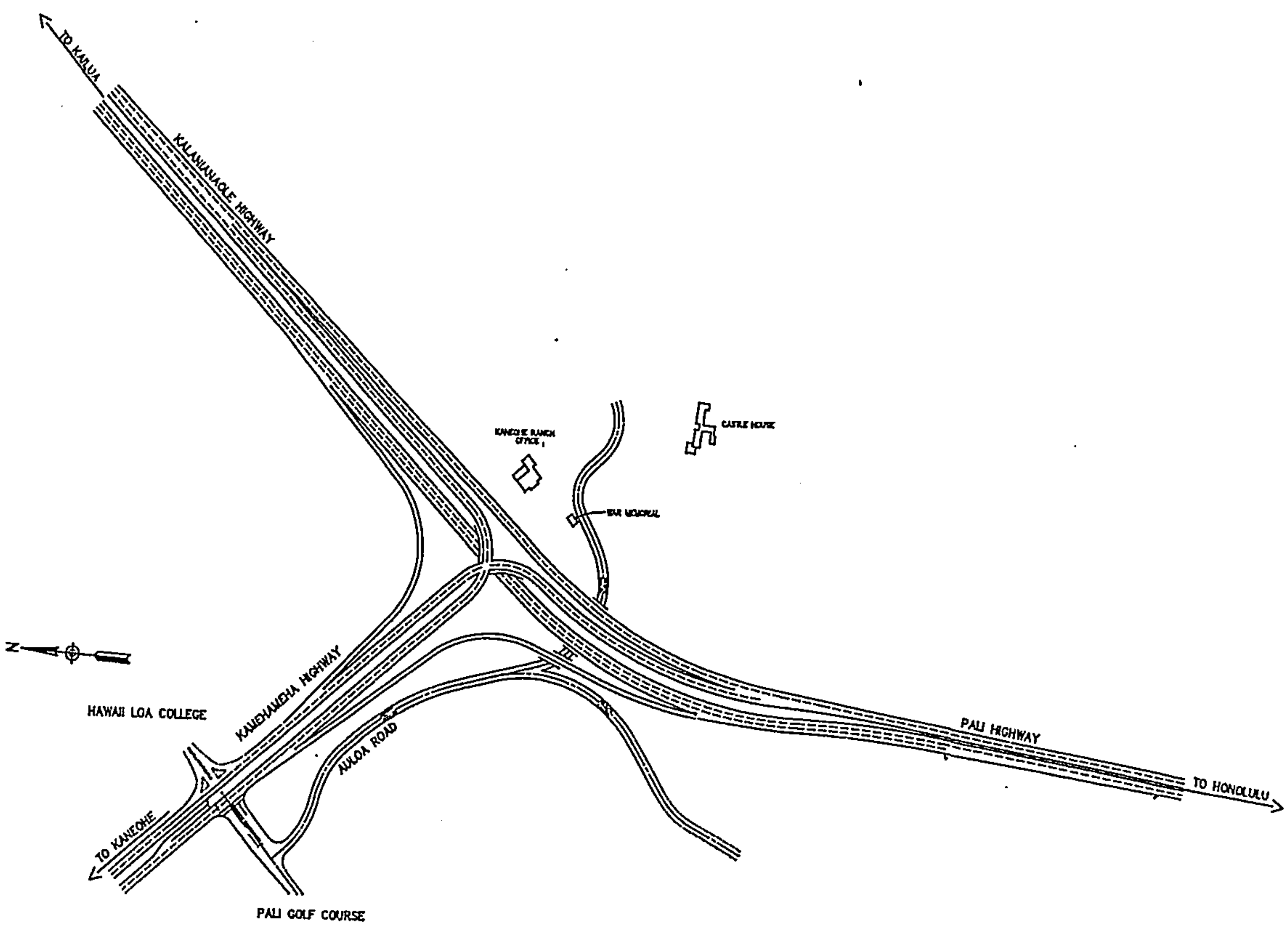
PARSONS HAWAII
THE RALPH M. PARSONS CO.
BARTON-ASCHMAN ASSOCIATES, INC.

(ALTERNATIVE C)
CASTLE JUNCTION INTERCHANGE STUDY



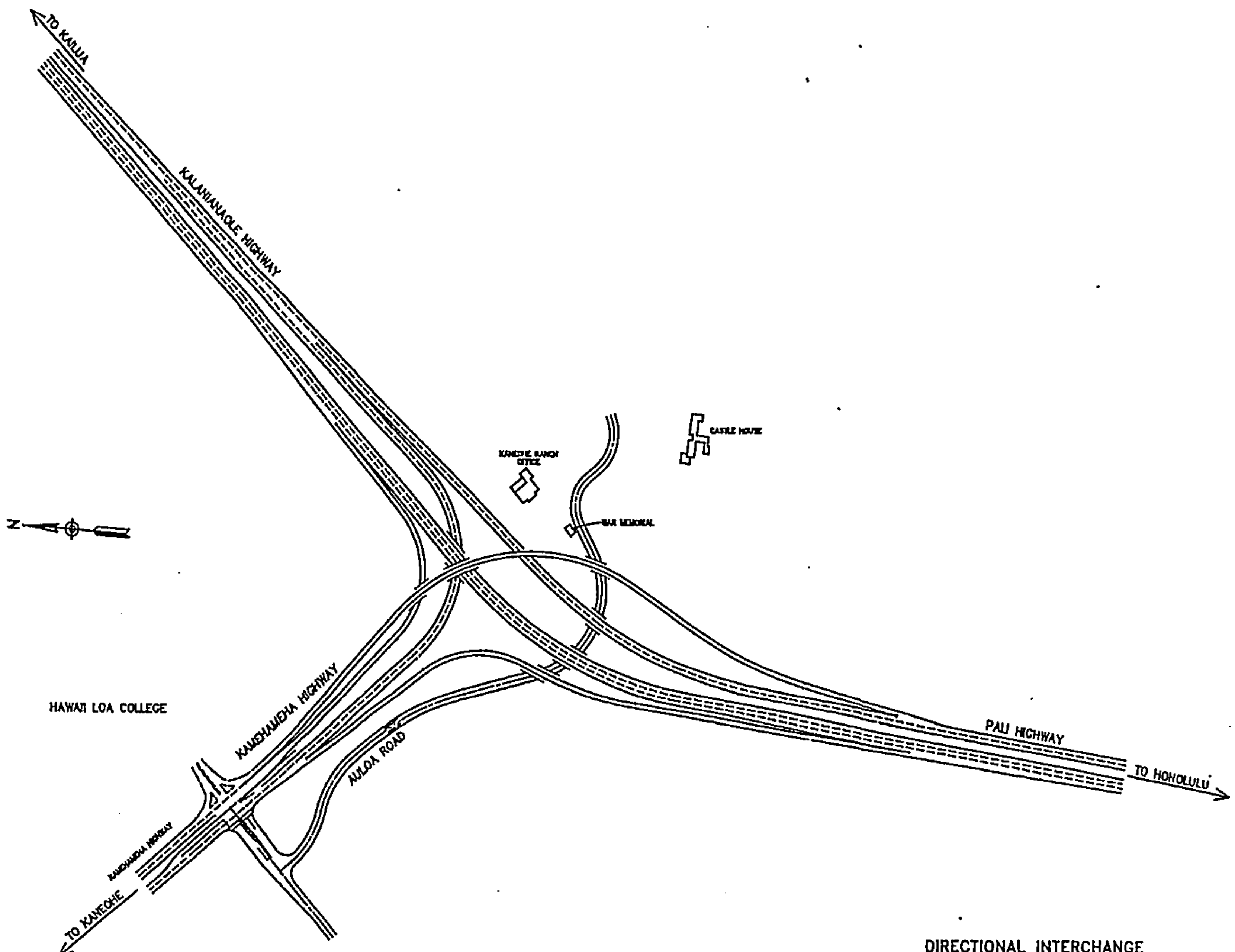
PARSONS HAWAII
THE RALPH M. PARSONS CO.
BARTON-ASCHMAN ASSOCIATES, INC.

(ALTERNATIVE F-3)
CASTLE JUNCTION INTERCHANGE STUDY



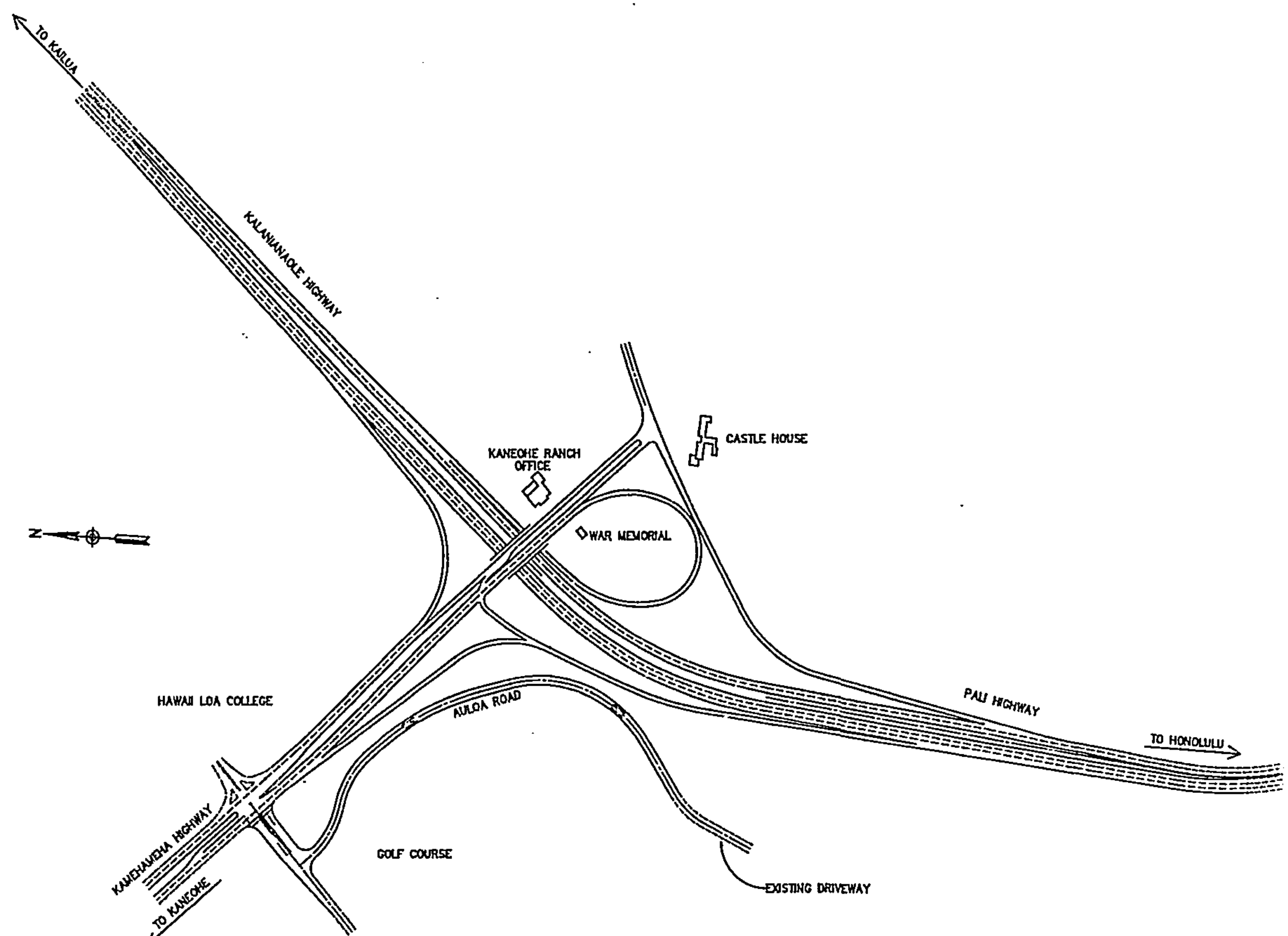
PARSONS HAWAII
THE RALPH M. PARSONS CO.
BARTON-ASCHMAN ASSOCIATES, INC.

MODIFIED URBAN INTERCHANGE
(ALTERNATIVE 8)
CASTLE JUNCTION INTERCHANGE STUDY



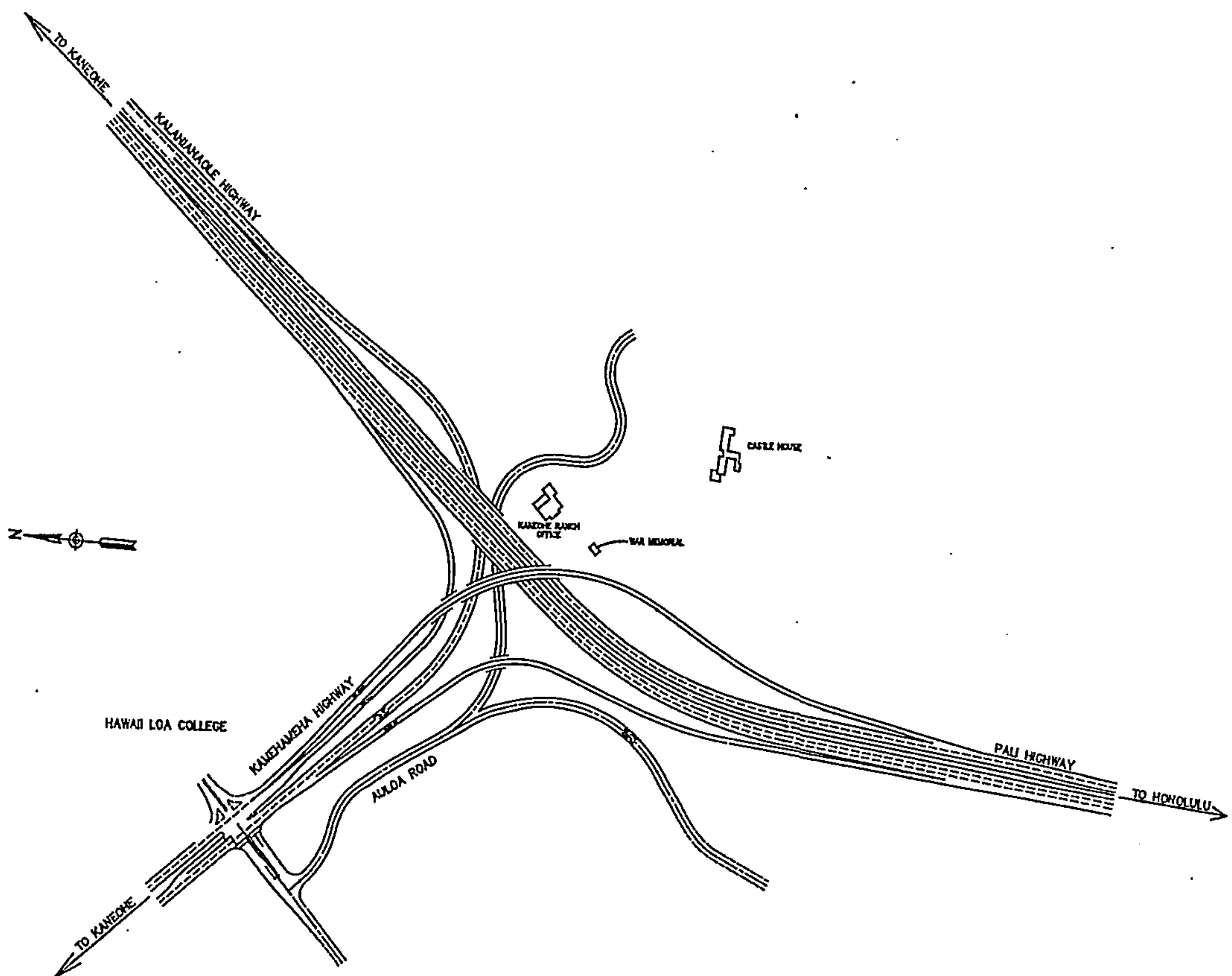
PARSONS HAWAII
THE RALPH M. PARSONS CO.
BARTON-ASCHMAN ASSOCIATES, INC.

DIRECTIONAL INTERCHANGE
W/ LEFT ENTRANCE RAMP
(ALTERNATIVE 9)
CASTLE JUNCTION INTERCHANGE STUDY



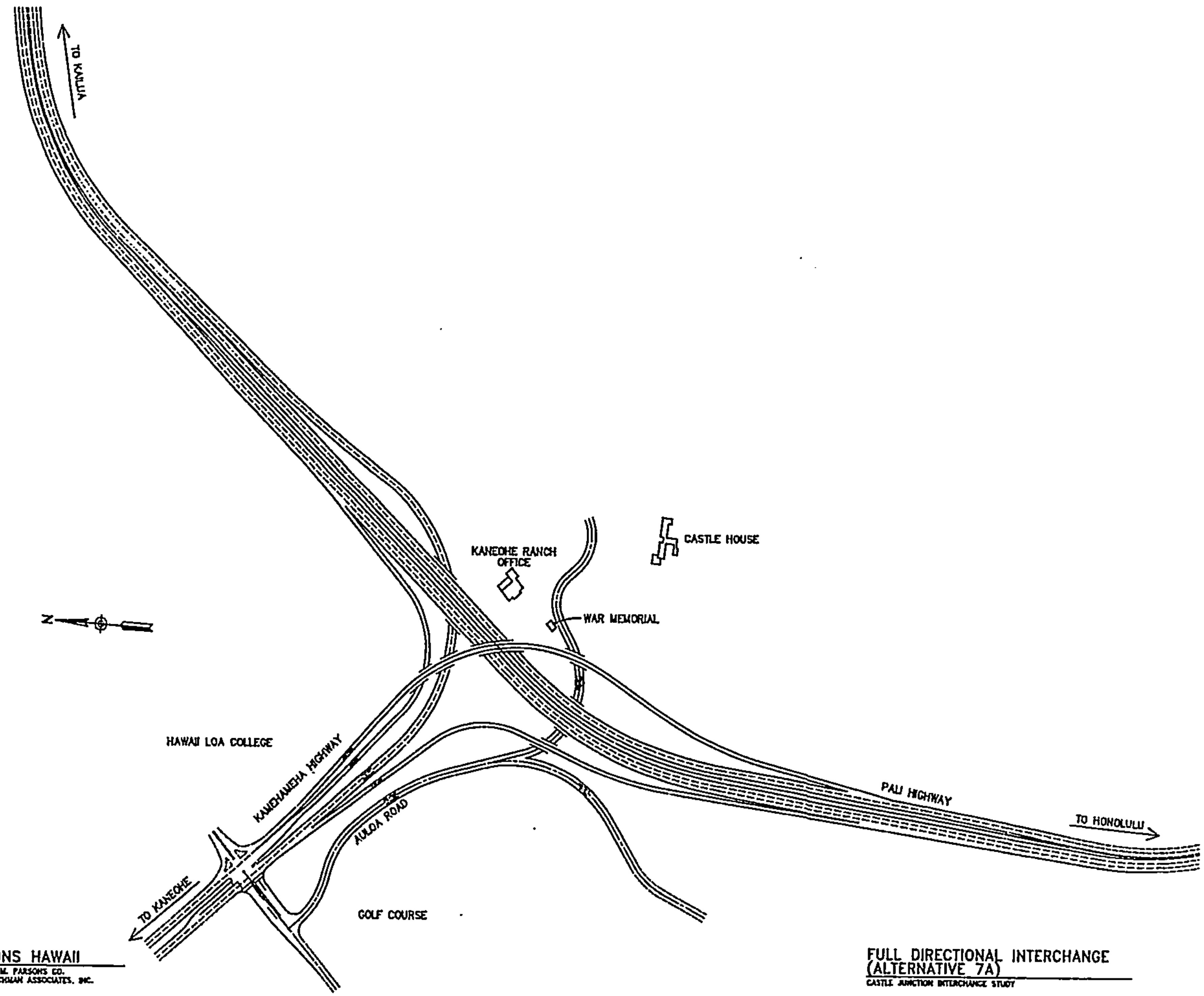
PARSONS HAWAII
THE RALPH M. PARSONS CO.
BARTON-ASCHMAN ASSOCIATES, INC.

PARTIAL CLOVERLEAF INTERCHANGE
(ALTERNATIVE 6)
CASTLE JUNCTION INTERCHANGE STUDY



PARSONS HAWAII
THE RALPH M. PARSONS CO.
BARTON-ASCHMAN ASSOCIATES, INC.

FULL DIRECTIONAL INTERCHANGE
(ALTERNATIVE 7B)
CASTLE JUNCTION INTERCHANGE STUDY



PARSONS HAWAII
THE RALPH M. PARSONS CO.
BARTON-ASCHMAN ASSOCIATES, INC.

FULL DIRECTIONAL INTERCHANGE
(ALTERNATIVE 7A)
CASTLE JUNCTION INTERCHANGE STUDY

PUBLIC INFORMATION MEETING
NO. 2

CASTLE JUNCTION INTERCHANGE

MAY 15, 1990

MAUNAWILI ELEMENTARY SCHOOL CAFETORIUM
Kailua, Oahu

MINUTES

1. Opening Statement - Mark Hastert, Commissioner on Transportation.

   a) Introduction of prominent guests: Representatives Ed Bybee and Marshall Ige; Councilman John Henry Felix.

   b) Description of purpose of meeting

      o Inform public of present status of DOT plans

      o Present preliminary interchange alternatives

      o Discuss environmental studies

      o Receive input and recommendations regarding alternatives

   c) Statement of meeting procedures

   d) Preview of meeting agenda

2. Introductory Statement - Ed Hirata, Director, State of Hawaii Department of Transportation

   a) Relation of Castle Junction Interchange project to overall direction of DOT

   b) Importance of and dedication to community input process

3. Overview - George Krasnick, Project Manager, Parsons Hawaii

   a) Introduction

   b) Project location and description

c) Scope of present study

- o conceptual design of interchange alternatives
- o preliminary planning and engineering, and
- o environmental impact analysis

4. Engineering Considerations - G. Krasnick

   a) Screening process and criteria (Began with 10, reduced to 6 for first public meeting, revised and altered due to input and studies, down to three for this meeting. Final not chosen yet.)

   b) Engineering Studies

   - o Geology (site currently has steep slopes with associated erosion problems - recommendations to reduce slopes and control erosion through ditches, etc.)
   - o Traffic (level-of-service: past, present and future with and without project; effects of H-3)

   c) Alternatives

   - o Overhead presentation of alternative interchange designs, including description of major design features of each alternative as well as how each impacts resources in the area
   - o Discussion of two non-interchange alternatives: transportation system management and no-build

5. Results of Environmental Studies - G. Krasnick

   a) Noise

   b) Air Quality

   c) Flora and Fauna

   d) Archaeology

   e) Erosion Potential

   f) Visual Impacts

6. Federal Funding Process / Timeline

a) Upcoming events: public review of environmental assessment, formal public hearing, selection of "preferred alternative"

b) Request for state and federal funds after completion of above tasks

c) Tentative schedule:

Public Hearing........... July, 1990
Complete Planning........ January, 1991
Begin Final Design....... July, 1991
Complete Final Design.... January, 1993
Begin Construction....... July, 1993
Complete Construction.... July, 1995

7. Break/Examination of Exhibits

8. Comments, Questions and Answers

C: DOT won't be able to fix traffic problems with only this interchange. You need to look at the whole system.

C: It does not make sense to have a signal at the college entrance.

R: The traffic light at the college entrance is a great concern to DOT. Preferably the light would be eliminated by restricting ingress and egress from the college to right turns only. In any event the proportion of red time on Kamehameha Highway would be very small.

C: Elimination of the left turn lanes is good.

Q: What will happen to the bus stops?

A: We have consulted with DTS regarding this issue. They conducted a survey and determined that the Pali Highway stops could be eliminated with very minimal impact to existing ridership. The stops in front of Hawaii Loa College and the Golf Course would remain. All current routes would be maintained. Transfers can be made at Maunawili Road to get to Castle Junction. This is detailed in the environmental assessment.

C: I would like to see a new alternative which would alleviate much of the congestion with much lower costs. It would entail having only one overpass, from Pali Highway to Kamehameha Highway, and would only allow left turns from Auloa Rd. and Kamehameha Hwy.

R: The greatest problem occurs in the morning. This would do nothing to help it. Traffic volume is so heavy that even with one light and minimal stopping time there still will be intolerable congestion. Also, from a technical viewpoint, even one overpass implies other changes such as the relocation of the college/golf course intersection due to the short merging distance which would be available. The solution is not quite so simple.

C: The traffic light for people traveling to Kailua is not the main problem, and the second left turn lane onto Pali Highway has really helped out with traffic from Kaneohe in the morning. The critical problem is in the p.m. when the left turn lane to Kaneohe backs up.

R: It is DOT's position that the light should be totally eliminated. As long as the traffic light is there traffic problems will occur, especially in the morning.

C: All of the interchange alternatives only have one lane for Kaneohe traffic to merge into free moving traffic. Currently, Kaneohe traffic experiences free moving conditions when the traffic light allows Auloa Rd. and Kamehameha Hwy. traffic to make left turns.

R: The interchange alternatives provide for a much improved merging situation. With three lanes, free flowing conditions and traffic moving at higher speeds there will be more room between cars. The ramp angles have been reduced and acceleration lengths increased to make it easier for traffic to merge. This will be much more like a mainland type on-ramp.

C: (Mr. Hastert) I strongly suggest that this modified alternative, i.e., only one crossover with traffic lights, be addressed in the EIS.

Q: The cost estimates seem very close, was the approach guided by a spending ceiling?

A: No, the cost estimator did not have a ceiling. We were also surprised by the similarities. We had expected alternative A to be least expensive.

C: Alternatives D and E should not be considered as alternatives, they should be dismissed.

R: They were included for comparison of environmental impacts.

Q: In order to meet the July, 1993 construction date funds will be needed soon. Will funds be requested at next year's legislature as part of the next biennium budget?

A: At a minimum we would need design money for the '91-'92 fiscal year.

Q: I see a two year construction period, does this mean the intersection will be shut down for this long?

A: No, one of the design requirements was to minimize impacts on traffic during construction. At a minimum, it will be possible to keep the same number of lanes open as currently exist through construction staging.

Q: The intersection is designed for three lanes, but the Pali Highway and tunnels have only two. Is contra flow considered the solution here?

A: We (DOT) are pursuing contra flow. The legislature has mandated that we do an EIS before we attempt to implement the program. We are currently in the EIS preparation phase.

C: There is a need to preserve the integrity of the "windward passage". Views should not be obstructed. What comes next? We do not want to see a cloverleaf in front of Olomana Heights. Because of the importance of preserving the integrity of the area, I would prefer Alternative C or nothing at all.

C: This project needs to be fully integrated with the whole transportation system. It won't do any good if there are bottlenecks at the tunnels or at junctions downtown. What about other improvements such as bus lanes and truck lanes? Trucks should not be traveling at peak times.

R: This project should go through on its own merits. We (DOT) do not think that we can do an integrated system design. H-3 will help alleviate the overall situation. Regarding adding bus or truck lanes, the highway has serious limitations in terms of widening and thus there is no way we can add such lanes.

C: The community is very skeptical, we would like you to think more in the way of an integrated system.

C: Fixing this one intersection will not do anything for the larger system due to problems at tunnels and downtown. The alternative with just one left turn overpass to Kaneohe will give much more bang for the buck.

C: Auloa Rd. is a major problem, especially in terms of accidents. Trucks going towards construction sites in the area are pushing people off the road. We need to deal with this problem. Should make it a one-way street. People use the entrances interchangeably. There should be more attention paid to it as an entrance/exit for Maunawili.

C: The Kamehameha to Pali movement is much better now with the additional left turn lane during the morning peak hour. The traffic light really helps to enable people to merge by stopping town bound traffic. Without it, things would be more dangerous. If it is changed back to one lane in the morning and the traffic light is eliminated, no one will move. I suggest taking a look at having only two lanes through the interchange with a third lane for traffic from Kaneohe.

R: The alternatives call for three lanes throughout the intersection. This will aid merging. The merging angle has also been lowered to 51 degrees, much better than the existing situation. Furthermore, the acceleration lengths have been increased substantially. The project has been designed for level-of-service C operations within the interchange. If design standards were lowered to D or less then eliminating the third lane for the sake of Kaneohe traffic could be considered.

Q: What is the need for this project when H-3 will lesson the load? Just one overpass will give more bang for the buck.

A: You are saying to go only half way. We are saying to go all the way. Regarding the proposed alternative, we will look at all comments.

Q: What kind of response will we get? I am not the only one here with these feelings (regarding the proposed alternative).

A: The director has requested the consultants to consider suggestions made here tonight and, if appropriate, to address them in the environmental assessment. If you would like to make any written comments or questions please address them to DOT or call 548-3258.

Q: Merging is more dangerous without the traffic light. Drivers will have problems. There should be only two lanes through the intersection. Why not have the third lane solely for Kaneohe to Honolulu traffic?

R: Based on comments being made we need to re-examine keeping only two lanes through the intersection.

C: During heavy rains Auloa Rd. is the only access to Maunawili as the lower road floods. Auloa Rd. should be left as is and the light should be adjusted to run longer. I am really concerned for Maunawili residents if we are left with only one exit.

Q: What will be the ramp speeds? I do not want to see speed restrictions on lanes which are designed to allow for fast moving merging.

A: All major ramps are designed for 50 mph, minor ramps have been designed for 25 mph. There will be no 25 mph speed limit signs on the major ramps.

CASTLE JUNCTION INTERCHANGE
PUBLIC HEARING

SUMMARY AND RESPONSES TO COMMENTS

The hearing was held on Tuesday, August 28, 1990, at the Kailua Intermediate School, 145 South Kainalu Drive, Kailua, Hawaii commencing at 7:48 p.m.

The Presiding Officer was Edward Hirata, State Department of Transportation Director. In attendance representing the project team from the DOT were: Ronald Tsuzuki (Planning Branch), Douglas Orimoto (Planning Branch), Jerry Iwata (Rights-of-Way Branch), Roy Kimoto (Traffic Engineer), and Kenneth Au (Advance Planning Engineer). Representing the consultant team were George Krasnick (Parsons Hawaii, Project Manager) and Phillip Rowell (Barton-Aschman Associates, Traffic Engineer).

Mr. Hirata began the meeting by making staff introductions. He then explained the purpose of the meeting and previewed the agenda. He noted that written testimonies would be accepted through September 11, 1990.

Mr. Krasnick made the presentation for the consultant team. He described the background of traffic growth through the intersection, the existing conditions at the intersection and the purpose and location of the proposed project. He then reviewed the scope of the study and pertinent details of the engineering tasks included therein.

The three interchange alternatives, trumpet, partially directional and fully directional, were described and illustrated in slides. The alternatives of transportation system management and no-build were discussed. The methodology used for ranking the alternatives was introduced, and the preferred alternative, the fully directional interchange, identified.

The environmental studies included in the project's scope were enumerated and results of the environmental assessment summarized.

Finally, the project schedule was presented.

Mr. Hirata then began the process of taking public testimony.

REPRESENTATIVE ED BYBEE

Comment: The community is strongly in favor of this project.

Comment: The alternatives seem similar, so choose the one which can be implemented the quickest.

Question: Is it planned to include this project in the 1991 biennium budget?

Response: Yes, funds for both planning and construction will be sought.

Question: What are the federal and state funding proportions?

Response: The federal share would be 75% and the state share 25%.

Question: Do you anticipate any problems with acquisition of the federal share?

Response: There will be several projects competing for a limited amount of funding. Allocation will be based on a priority system, but we don't know the relative priority of this project. It's conceivable that the state legislature would find the project of high enough priority to fund the project entirely if federal funding is significantly delayed.

CITY COUNCILMAN JOHN HENRY FELIX

Comment: The interchange is overdue, and inflation is making it more expensive.

Comment: Recommendation of a specific alternative design will be made after review of the environmental assessment and community input.

Comment: The Director and staff are to be commended for providing for public input throughout the planning of this project.

Comment: The Auloa Road access in Alternative C seems circuitous and time consuming.

Response: Alternative C is the only alternative that provides full access to Auloa Road. Although additional driving is required for some of the movements, because of changes to signal phasing, the actual elapsed time will be reduced for the major movements.

Comment: Costs are a concern; benefits must justify expenditures.

Question: Has the state coordinated with the City's Department of Transportation Services?

Response: Yes, DTS and a number of other City departments have been consulted with in development of the project. DTS provided recommendations, traffic data for Auloa Road, topo's for Auloa Road, and design guidelines.

Question: What were DTS's recommendations for Auloa Road?

Response: DTS has no plans to improve Auloa Road, but they were in favor of improved access to the Maunawili Area.

Comment: The Director and staff are to be commended for their availability and diligence.

MR. ANDREW YANOVIAK

Comment: Although he is in favor of the project, he takes exception to the approach taken in planning and design. He feels that not enough attention was paid to aesthetics which are important because of the setting and our visitor industry. He is concerned about blocking scenic vistas. Photographs with the proposed interchange superimposed on the view should be produced.

Response: Mr Yanoviak's dissatisfaction may result from his lack of knowledge of the full scope of the project (what was included, what was excluded, and why), his lack of familiarity with the environmental assessment, and his failure to have participated in the two previous public informational meetings at which many of his questions and concerns were addressed. The environmental assessment includes an analysis of the project's impacts on important vistas in the area. The fact is, Castle Junction is almost invisible from anyplace except the immediate surroundings. This was confirmed in slides which were shown to the public at the first public informational meeting. The effects on views of the Koolaus from the college were further studied by superimposing drawings of the alternatives onto drawings made from photographs taken from various positions on the campus. Impacts would be very minimal. It is true that the aesthetics of the structures have not been studied. The present contract is to produce <u>conceptual</u> alternatives. Architectural considerations will begin in the preliminary design stage, not yet underway. At that time, a state committee of senior architects will be employed to review the design.

Comment: The drawings of the alternatives don't have topographic contours. There are no three-dimensional models. There are no elevation-type drawings.

Response: All of the drawings were generated by computer using a CADD (computer-aided design and drafting) system. We have the topographic data on a separate layer of the CADD file, and some of the working drawings included the topographic data. For the Public Hearing we felt the drawings would be too cluttered with this information.

We also generated complete profile drawings for all portions of the various alternatives. These were necessary to do the calculations of cut and fill volumes and the cost estimates. Three-dimensional models were discussed in the pre-contract negotiations, but were rejected because of excessive cost and limited benefit.

Comment: The traffic studies don't show the directional flow of traffic and the counts.

Response: Complete directional data are provided in the traffic study appended to the environmental assessment.

Comment: It would be beneficial to show the community how the number of alternatives was reduced from ten to three.

Response: The primary reason for the first of the two public informational meetings held prior to this public hearing was to present all ten alternatives for public review, describe the methodology to be used to rank them, and invite public comment. If one does not avail oneself of the opportunity to participate, it does not invalidate the opportunity.

Comment: The drawings should show the surrounding buildings to scale.

Response: All structures shown on the drawings are drawn to scale.

Comment: The plans for terracing, benching and landscaping of the hillsides should be presented.

Response: Included as an appendix to the environmental assessment is a thorough analysis of the erosion and siltation potentials of the three alternatives. Estimates of soil loss were generated, and the quantitative effects of various mitigation measures calculated. The actual measures to be employed will be selected in the design phase.

Comment: A full environmental impact statement should be produced, because this is an important area.

Response: At the federal level, the process being followed complies rigorously with the requirements of the National Environmental Policy Act (NEPA) and the guidelines for compliance produced by the Federal Highway Administration. At the state level, we are in compliance with Chapter 343, Hawaii Revised Statutes, "Environmental Impact Statements," and Chapter 11-200, Hawaii Administrative Rules, entitled "Environmental Impact Statement Rules." The state and federal processes are similar in that certain classes of actions trigger environmental assessment. If the results of that assessment indicate that significant environmental impacts may occur as a result of implementation of the proposed project, then an environmental impact statement is required. In the present case, the results of the environmental assessment do not indicate that significant impacts would occur, and therefore, a full environmental impact statement would serve no purpose other than to expend unnecessary time and money. The qualitative opinion that this is an important area is insufficient to trigger an environmental impact statement.

Comment: Federal design standards should be taken into account.

Response: It is intended that the federal government provide 75% of the funding for this project. Obviously federal standards apply to federal projects, and the project team has been working with the local representatives of the FHWA since the beginning of the project.

Comment: Blockages of lanes during construction should be examined.

Response: The traffic impact study produced for the project and appended in its entirety in the environmental assessment includes an analysis of project phasing to reduce impacts to traffic flow during construction.

Comment: The traffic analysis should include time of day, time per week, time per month, and time per year.

Response: Traffic impact analysis is generally done on the basis of impacts to the level of service during the morning and afternoon peak hours. This was the procedure followed in this study. When scheduling traffic counts, Monday mornings and Friday afternoons are not used because of their atypical traffic patterns. In Hawaii, a major seasonal difference is seen between summer, when school is out, and winter, when school is in session. The traffic projections used in this study were based on worst-case winter volumes.

MS. BONNIE HYMAN

Comment: The official recommendation of the Kailua Neighborhood Board is Alternative C, the fully directional alternative.

Comment: One concern is the rerouting of Auloa Road behind the Kaneohe Ranch Office. They would prefer a less circuitous route, more like what now exists.

Comment: The Board is concerned about the appearance of the structures. They don't want massive structures like those for the airport viaduct. Good design and landscaping could enhance the appearance.

Response: The appearance of the structures will be determined later in the project, during the design stage. The State Historic Sites Branch has requested to be involved in review of the design to ensure an appropriate appearance. It may be practical to incorporate design elements similar to what now appear in the structures further up the Pali.

Comment: Kawainui Marsh and Kaelepulu Pond should be protected from siltation. Cuts should be landscaped.

Response: Included as an appendix to the environmental assessment is a thorough analysis of the erosion and siltation potentials of the three alternatives. Estimates of soil loss were generated, and the quantitative effects of various mitigation measures calculated. The actual measures to be employed will be selected in the design phase.

Comment: This project needs to be done soon.

COUNCILMAN FELIX

Question: Are the architects on the review committee paid?

Response: Yes.

Question: Who is on the committee?

Response: Val Ossipoff is the dean of architects in Hawaii, and he is one member.

Question: Were these people specifically retained for this project?

Response: No. they review all structure designs for the state.

Question: Is this an ongoing panel?

Response: Yes.

Question: Did you (Mr. Hirata) select the panel.

Response: No.

Question: Do they serve for a specific term?

Response: No.

Comment: The panel is a great idea, and the Director is to be commended for putting it into place.

Question: Is the panel required by law?

Response: This is the policy of the Department.

Comment: This is an excellent practice and should be continued.

REPRESENTATIVE BYBEE

Comment: Looking at the schedule, it appears that you will need the entire amount of the budget in the 1991 biennium budget.

Response: That is correct.

Comment: That's good. I want to get this project done.

Comment: An EIS would delay the project at least a year. If we don't fund it in the upcoming biennium, it would mean at least a two year delay. An EIS is not necessary.

MR. YANOVIAK

Comment: When I worked with Dr. Matsuda at the Department of Transportation, the panel (Val Ossipoff, Alfred Preis and George (Pete) Wimberly) were involved earlier in the process, including in selection of alternatives.

Response: The present contract is to look at functional alternatives, not design. There remains ample time in the process to retain flexibility in design.

Comment: Proper environmental site planning design can include the requirements for an EIS. If you do your planning and design properly, you can preclude the need for an EIS.

Response: The purposes of the EIS process are to disclose the project and its environmental consequences to the public for review and comment and to give decision-makers an objective basis with which to weigh the costs and benefits of the project. The requirement for public involvement is not satisfied by producing a good design.

Comment: Drainage and sheet flow studies should be done prior to selection of alternatives.

Response: Included as an appendix to the environmental assessment is a thorough analysis of the erosion and siltation potentials of the three alternatives. Estimates of soil loss were generated, and the quantitative effects of various mitigation measures calculated. The actual measures to be employed will be selected in the design phase.

Comment: This project warrants 3-D modeling and computer simulation studies.

Response: Neither the schedule nor the budget would support that approach, but more importantly, we do not feel these types of studies are necessary for this project. We will evaluate their use for future presentations.

Question: Why would the state want to fund the project 100%?

Response: The federal budget for primary highways in Hawaii in about $14 million per year. If a project is not a high enough priority, it may not get funded. If the state wants to accelerate construction in response to community concerns, then 100% state funding would be required.

COUNCILMAN FELIX

Question: When the interchange was originally proposed, what was the cost?

Response: Twenty years ago it was on the order of $10 million.

Comment: I just want to point out that time and inflation are cruel.

MR. ALAN BAIL

Question: Are there any elevations or profiles?

Response: Yes, they may be found in Volume II, the Technical Reference Document, of the environmental assessment.

Question: How high, in feet, above the present intersection at Castle Junction is ramp C, in Alternative C?

Response: About 22 feet.

The hearing was closed by Mr. Hirata at 9:45.

Appendix K

SIGNIFICANT AGENCY CORRESPONDENCE

United States Department of the Interior

FISH AND WILDLIFE SERVICE
300 ALA MOANA BOULEVARD
P.O. BOX 50167
HONOLULU, HAWAII 96850

23 FEB 1990

Mr. George J. Krasnick
Parsons Hawaii
567 South King Street
Suite 105
Honolulu, Hawaii 96813

Dear Mr. Krasnick:

This follows up my telephone conversation of earlier today with Mr. Rory Framtton of your office concerning the proposal to construct a traffic interchange at Castle Junction at the intersection of Kamehameha Highway and the Pali Highway, Kaneohe, Hawaii.

To the best of our knowledge, there are no listed or proposed endangered or threatened species of plants or animals which are present in the vicinity of, or would be affected by, the project.

Thank you for the opportunity to comment on the proposal.

Sincerely yours,

William R. Kramer

William Kramer
Acting Field Office Supervisor
Fish and Wildlife Enhancement

DEPARTMENT OF PARKS AND RECREATION

CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

WALTER M. OZAWA
DIRECTOR

ALVIN K.C. AU
DEPUTY DIRECTOR

August 16, 1990

Mr. Douglas Orimoto
State of Hawaii
Department of Transportaion
869 Punchbowl Street
Honolulu, Hawaii 96813

Dear Mr. Orimoto:

Subject: Proposed Castle Junction Alignment

As discussed at the meeting of August 14, 1990 concerning the subject alignments, the Department of Parks and Recreation has no objections to the three alignments. Present and future planning for our Pali Golf Course will not be impacted by the proposed alignments.

Sincerely,

WALTER M. OZAWA, Director

WMO:cz

cc: Facilities Development

Jhy 1272

OFFICE OF STATE PLANNING

Office of the Governor
STATE CAPITOL, HONOLULU, HAWAII 96813 TELEPHONE (808) 548-5893

JOHN WAIHEE, Governor

Ref. No. P-1408

October 29, 1990

MEMORANDUM

TO: The Honorable Edward Y. Hirata, Director
Department of Transportation

SUBJECT: Hawaii Coastal Zone Management (CZM) Program Federal Consistency for the Castle Junction Interchange, City and County of Honolulu, Hawaii (FC/90-025)

This is to inform you that we have reviewed your assessment of the subject activity's consistency with Hawaii's CZM Program and concur with your finding that the activity is consistent. Therefore, Hawaii CZM consistency approval is hereby granted. By copy of this letter, we are informing the U.S. Department of Transportation that CZM consistency review requirements have been met.

This approval does not excuse your compliance with any regulations administered by any other State agency or the City and County of Honolulu.

Harold S. Masumoto
Director

cc: Federal Highway Administration
Department of Land and Natural Resources
Department of Land Utilization

3:5 PM '90

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE HISTORIC PRESERVATION DIVISION
33 South King Street, 6th Floor
Honolulu, Hawaii 96813

WILLIAM W. PATY, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
KEITH W. AHUE
MANABU TAGOMORI
RUSSELL N. FUKUMOTO

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION PROGRAM
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

REF: HP-JE

NOV 27 1990

MEMORANDUM

TO: Honorable Ed Hirata, Director
Department of Transportation

FROM: William W. Paty, Chairperson and State Historic Preservation Officer

SUBJECT: Castle Junction Interchange

HISTORIC PRESERVATION CONCERNS

Thank you for the opportunity to review the Environmental Assessment for the Castle Junction Interchange. As the result of the meetings between your planning staff and Don Hibbard of our State Historic Preservation Division, we concur with the State Department of Transportation and the Federal Highways Administration's determination that this proposed project will have no effect upon any historic properties within the project area. We are of the understanding that the proposed overpass will be architecturally sensitive to its surroundings and that any overpass plans which are developed will need the approval of our department.